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ABSTRACT

Major inequalities in the level of educational expenditures per student among school districts have been cited as an indication of the need for structural reform of the public educational system. The purpose of this research project was to see if market structure has any effect on the output of public educational services, and, if so, to see how this effect would influence the probable outcomes of the major reform proposals. In order to carry out this project, a three equation econometric model of the market for public school teachers was specified and estimated. This market was selected because teachers' salaries are the largest single component of costs for the average district and because the quality of teachers determines the quality of education offered. Results show that the degree of "competition" among school districts is positively associated with both the revenues appropriated for education and the wage paid to the instructional staff. The study concludes that some proposals for educational reform would, in the long run, decrease the total output of the educational sector. (Author/MLF)

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POLITICAL FRAGMENTATION AND THE DEMAND FOR EDUCATIONAL SERVICES: AN ECONOMIC ANALYSIS

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CHAPTER 1

INTRODUCTION

There has always been much controversy about what constitutes the best system for educating the young people of the United States. Any armchair philosopher can with little effort recall the many educational issues that he has debated just within the past decade. Busing, neighborhood control of the schools, "new" math, the teacher's right to strike, and political activism in the schools are all topics that have captured major shares of newsprint and broadcast time in but little more than ten years. By retreating only a bit further into history, we would wonder "why Johnny can't read", or why Russian children could grow up to build a sputnik when American children could not.

The current "hot" issue in American public education concerns the inequality of financial resources and the resulting expenditures per student among school districts within states and across the country. Consider, for example, the following excerpts from a recent decision by the Supreme Court of the State of California:

> Tax bases vary widely throughout the state; in 1969-70, for example, the assessed valuation per unit of average daily attendance of elementary school children ranged from a low of $103 to a peak of $952,156 -- a ratio of nearly 1 to 10,000.[1]

> For example, in Los Angeles County,... the Baldwin Park Unified School District expended only $577.49 to educate each of its pupils in 1968-69; during the same year the Pasadena Unified School District spent $840.19 on every student; and the Beverly Hills Unified School District paid out $1,231.72 per child.[2]

Similar statistics and arguments have been raised in the courts of many other states. Although the United States Supreme Court has to date not found a violation of the Constitution of the United States in these cases, some state courts have ruled that such inequality is in violation of state constitutions and thus must be eliminated.

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[1] Serrano v. Priest, In the Supreme Court of the State of California, L.A. 29820, Super. Ct. No. 938254, p. 8.

[2] Ibid., p. 12.

[3] In Rodriguez vs. San Antonio, the United States Supreme Court stated that it was not unconstitutional to finance education through a system of locally administered property taxes. The Supreme Court of the State of New Jersey held that the property tax system in that state was in violation of the State constitution in deciding the case of Robinson vs. Cahill.

The hope in all cases along these lines is that the elimination of the inequality of educational expenditures per student will in the long run eliminate extreme disparities in wealth and income in the country. As Jencks has stated, "The case for equalizing the distribution of schooling and cognitive skill derives not from the idea that we should maximize consumer satisfaction, but from the assumption that equalizing schooling and cognitive skill is necessary to equalize status and income."[4] Compounding the complexity of the issue of financial inequality among schools is an important related issue of civil rights. Because the students of the low-expenditure schools are often members of minority groups, it is contended that the existence of such inequality is but another form of unconstitutional discrimination.

The issues of school finance, income, and race have combined to become a platform for educational reform in the United States. While reform proposals are many and varied, they are all similar in that each has some provision that would alter the structure of the market for public education. The implicit assumption behind the proposals is that the change in the market would not affect the total supply of revenues to the educational sector nor the demand for its services.[5] The research staff for the project described in this document is uncomfortable with this assumption. As economists, we have witnessed many times over that there is almost always some side-effect to any policy that restructures or constrains an economic market. Frequently the side-effect serves partially to offset the desired goals of the restructuring. For example, increasing the minimum wage rate seems to be an efficient and simple way of increasing income for the poor, but considerable research has shown that a rising minimum wage is accompanied by higher unemployment rates, especially among black teenagers.[6] More recently, housewives in the United States have seen that a ceiling on beef prices may mean that there is no beef to be sold. It is important to examine the educational market to see if it too reacts to outside restrictions or pressures that are placed upon it. We believe that the enclosed materials successfully complete such an examination.

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[4]Christopher Jencks, et. al., Inequality: A Reassessment of the Effect of Family and Schooling in America, (New York: Basic Books, Inc., 1972), p. 11.

[5]There are of course exceptions to this statement. The proposal of Milton Friedman, described below, is based wholly on the idea that market structure and performance are inextricably intertwined.

[6]In a recent article, Thomas G. Moore found that for every increase of one percent in the minimum wage as a percent of average hourly earnings, the unemployment rate of nonwhites aged sixteen to nineteen increased by 1.88 percentage points. Thomas Gale Moore, "The Effect of Minimum Wages on Teenage Unemployment Rates", The Journal of Political Economy, LXXIX (July/August, 1971), pp. 897-902.

This chapter serves as an introduction to the methods, results, and conclusions of our research. Part I of this chapter explains how the market for educational services in many respects could be made similar to other markets for goods and services. Part II explores the "public" nature of education and explains why educational systems have developed as they have. It also shows how great disparities have been created and discusses popular reform proposals. Finally, Part III outlines the remainder of this research report.

Economic Characteristics of Educational Services

Educational services resemble in many ways the other goods and services that are purchased by households, corporations, and other institutions. Consider, for example, some of the similarities between educational services and health care services. A family purchases the services of a physician for several reasons. First, there is the obvious enjoyment that is derived simply from "feeling good". In this respect, health services are a consumer good as much as other goods and services that provide enjoyment to the purchaser. Secondly, it is difficult for a person to advance in his career if he is in poor health. Finally, today's purchase of health services means that the purchaser will probably be healthier in the future than he otherwise would have been. He is sacrificing the other goods and services that he could have enjoyed today by purchasing better health in the future. These last two reasons illustrate the investment side of the purchase of health services in that financial resources are given up today in exchange for some benefits that become available in the future. Other reasons for purchasing health services could be given, but these are sufficient for our comparison.

Each of the reasons described above has a counterpart in the purchase of educational services. Because education yields current benefits such as the ability to calculate and to read, many households would purchase this service as a consumption good. In addition, the attainment of a higher level of education also increases the potential lifetime income to the individual. In economic terms the discounted value of the higher expected earnings in the future is greater than the cost of getting more schooling, so the expected rate of return to more education is positive. In fact, many studies show that the rate of return from education to an individual is generally greater than the rates of return that he can obtain on purely financial investments elsewhere in the economy. Thus, education is an investment good for individuals.[7]

For these reasons, there is no reason why educational services could not be offered through a system of uncontrolled private markets. Individuals wishing to shop for these services would compare the products offered by suppliers and select those that meet the blend of quantity, quality, diversity, and price that they seek. If there were many such suppliers, the price of educational services would approximate the actual costs of providing those services. The total quantity of education consumed would vary from household to household. Since each household would bear the entire cost of its own education, it would have to consider the opportunity cost of purchasing this education. That is, by buying an extra year of schooling for

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[7] These concepts are explored and illustrated in great depth in B.F. Kiker, ed., Investment in Human Capital (Columbia, S.C.: University of South Carolina Press, 1972).

a child at a cost of $1000, the family would be sacrificing other things such as new carpeting, a pleasant vacation, braces for a teenager's teeth, and so on. The family would then have to evaluate the possible goods and services that it could buy with its income and savings and then establish a set of priorities. Presumably, a rational family would continue to expand its purchase of educational services until the last dollar spent on education would yield as many benefits as the family could get if it spent the dollar elsewhere. Because the perception of benefits will vary from family to family, the amount of education purchased would vary. Moreover, many families would feel that the services obtained from established schools could be equally well obtained by self instruction, by educational television, or from personal tutors. These families would presumably purchase smaller amounts of education from organized school systems than would other families of similar incomes. Finally, we would expect that such a system would lead to a distribution of education that closely follows the distribution of income and wealth. Just as the very wealthy of our society receive more and better health care than the poor, we would expect that a market delivery system for educational services would give more and better education to the rich than to the less wealthy. Indeed, we would expect that some of the very poor would choose to purchase no education at all under such a system.

Education as a Merit Good[8]

The previous section explained how education could be offered to households through a market system of delivery. This section explains why that system is not used.

A market system is an efficient form of organization for delivering goods and services that affect the satisfaction and well-being of only the consumers of those goods and services. Consumers are able to get the types and qualities of the goods that they seek, and profit maximization generally insures that these goods are produced efficiently. Price variability will eliminate surpluses and shortages. Consumer choice will be maximized.

A market system may not be an efficient form of delivery if a particular good bestows benefits or damages upon individuals other than the consumers of that good. We can best illustrate this fact by considering education as an example. In any society, and especially a democratic one, each family benefits when the educational attainments of other families increase. A higher level of overall education hopefully leads to a more open discussion of political ideas, an expansion of the arts, and a more fruitful life for all.[9] Accordingly, each family should technically be willing to buy some of these benefits by purchasing education for others,

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[8]The best detailed discussion of many of the topics in this section may be found in Richard A. Musgrave, The Theory of Public Finance (New York: McGraw-Hill Book Co., Inc., 1959), Part I.

[9]For a more complete discussion, see Burton Weisbrod, External Effects of Public Education: An Economic Analysis (Princeton: Princeton University Press, 1964), pp 15-39, 95-99.

but a market system minimizes the likelihood of this happening. Free-will donations to an educational charity will not raise revenues commensurate with the benefits obtainable because of the "free rider" problem. That is, any single donor may think that his donation is such a small portion of the total that it would not be missed. Therefore, he will not give it. On the other hand, if he thinks that many others will not make donations, then his donation will not be large enough to do any real good. Therefore, he will not give it. Any family that considers giving money to other families directly may feel that if it spreads its money over many families, the net impact per family will be too small. If it gives to only one family, it may feel that the net impact on society is small or that the recipient family may substitute the gift for its own expenditures on education. In any case, a voluntary program will lead to a smaller quantity of education than is socially desirable. To remedy this problem and to insure that education is available to those who would be too poor to afford any in a free market, the states have required that free public education be made available, and that all children up to a certain age attend schools. That is, education is considered to be so meritorious by society as a whole that the state uses its coercive power to guarantee its provision through involuntary taxation.

The involuntary program of educational support that has been developed is of course quite familiar. Through elected state and local boards, communities have established the amount of education to be offered and have instituted tax systems to raise the required revenues. Dual state and local systems have developed to take into account the spillovers among communities. A purely local effort could insure that the level of education desired by residents of the community was forthcoming, but variations in income and tastes among communities would cause some to provide a smaller amount of education than was optimal in terms of the entire society. Accordingly, state governments have developed minimum foundation programs that guarantee that some nominal amount of education will be received by every child in the state and developed state aid programs to support that guarantee where local revenue sources are insufficient.[10] Typically, the states have not placed a ceiling on the amount of education that a local community could provide.

The most common tax base for the educational revenue systems is the market value of property, a choice which has lead to much of the inequality of expenditures described in the introduction to this chapter. Because the value per student of such property varies substantially from community to community, it is inevitable that the expenditures per student that result also vary substantially. Establishment of a "floor" on the amount of expenditures per student has served to mitigate some of this inequality, but the inequality can never be completely removed as long as the floor is well below what the wealthy districts desire to spend and as long as they are not restricted in how much they can spend. Moreover, if the state aid formulas grant more or less equal amounts to all districts, then the absolute amount of the inequality among districts is not affected by the state aid program.

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[10] This argument also supports the ideal of a federal minimum support program. Because of the great mobility of American families, there are substantial spillovers from education among states as well as within them.

In the light of the statistics detailing the magnitude of the inequality, many proposals for change to eliminate much of the variation in expenditures per student have been offered. They seem to fall into the following categories.

1. An effective change in school district boundaries. In this approach, the boundaries of the school system would be redrawn to equalize the values of the tax base per student among the districts. This done, the state would specify the minimum revenue per student that must be raised and then let the individual districts go above the minimum by whatever amount they wished. Under such a system, any variation in expenditures per student would reflect genuine differences in willingness to sacrifice other goods and services in exchange for greater education. Under the present system, it is argued that the great disparities in expenditures per student are achieved without any meaningful sacrifice on the part of the wealthy districts.[11] Operationally, this approach could be implemented by gerrymandering the existing school districts and providing busing where distances from homes to schools are great as a result.

2. A voucher system. This approach attempts to achieve the virtues of the market form of organization. In its extreme form, it suggests that each student receive a state voucher equal to the state minimum expenditures per student. This voucher would be acceptable in payment of tuition at any state approved school, public or private. The state voucher could be augmented by vouchers from local communities and by additional funds from the student and his parents. Inequality would not be eliminated under this plan, but it would increase the range of choices available to families, especially poor ones.[12]

3. The unit state district. This proposal would permit only one school district in each state, as has been done in Hawaii. Funds would be collected and disbursed by the state in such a manner as to equalize expenditures per student. The state board would make all hiring policies and design the educational curricula.

4. State leveling of local districts. This approach is a collection of different proposals that call for the retention of local school districts under fairly strict financial control by the state. Some popular variants are:

   a. A state ceiling on expenditures. Each district would be restricted in the amount that it could spend per student. The ceiling could be made equal to the floor if strict equality were to be sought. It could be implemented over a period of

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[11] Consider the cases of Baldwin Park and Beverly Hills cited on page 1. In Baldwin Park, a tax rate of $5.48 per $100 of assessed valuation yielded $577 per student. Beverly Hills raised $1231 per student with a tax rate of $2.38 per $100. Of course, an ideal system of equalizing market value would equalize both the market value of residential property and the market value of commercial-industrial property. Otherwise, equal tax rates might not represent equal willingness to sacrifice.

[12] The best economic defense of this is in Milton Friedman, Capitalism and Freedom (Chicago: University of Chicago Press, 1962), Ch. II.

years by freezing the expenditures of local districts that were spending more than the statewide average per student.[13]

b. Matching by wealth. Another variation argues that the state aid formula should give to the very poor districts the amount of money that would have been raised if the tax rate in the poor district had been applied to the assessed value per student of the rich districts. The effect of this plan would be to give the same amounts of money per student to districts making the same tax sacrifice. It would equalize expenditures only insofar as districts wished to make the same sacrifices.[14]

c. State collection and distribution of taxes. This approach would equalize expenditures by having the state levy taxes and distribute the revenues among the local districts in equal amounts per student. It would still give curriculum control and authority over making the actual expenditures to the local boards.

The Purpose of this Research

All of the proposals outlined above are sincere efforts on the parts of their proponents to develop an educational organization that is "fair" to all students. Each proposal has different merits and disadvantages. The authors of this report are interested in these proposals because each would influence the market structure of the educational sector. Implementation of any one of these proposals may affect the evaluation of costs and benefits from education by voters and thus affect the amount of revenues that are forthcoming to that sector. Moreover, the change in structure may itself have effects on prices and quantities in that market, much as in other markets in our economy. In this research, we seek to determine what consequences, if any, result from a change in the structure in the educational market. Then, we propose to evaluate these consequences to see if they enhance or negate the primary objectives of the proposed reform.

The research will be conducted by the development of an econometric model of the educational sector. Chapter 2 explains the methods that will be used in the research, and explains the principal hypotheses. Chapter 3 presents the statistical results and evaluates the reasonability of them. Chapter 4 offers conclusions based on these results and discusses these reform proposals in the light of the results. Finally, Chapter 5 offers some tentative recommendations based on the research.

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[13]The Fleishman Report prepared for the legislature of the State of New York is an example.

[14]A popular variation, called "power equalizing", is presented in John E. Coons, William H. Clune III, and Stephen D. Sugarman, Private Wealth and Public Education (Cambridge, Mass.: The Belknap Press, 1970).

CHAPTER 2

RESEARCH METHODS

At present the principal research tool of the economics profession is a blend of statistical and mathematical techniques collectively called econometrics. Part I of this chapter provides of a brief explanation of econometric methods. Part II explains how the econometric model covering the central hypotheses of this study was specified.

Econometric Methods[1]

Econometric techniques are statistical and mathematical methods developed largely by economists to show how the variation in one variable or set of variables can be explained by or attributed to the variation in a different variable or set of variables. While simple correlation analysis can explain the degree to which any single variable is associated with any other variable, the use of this approach is limited in that causation is never certain, and that it cannot suitably cope with relationships among more than two variables. Factor analysis or the method of principal components can be employed to develop new variables that explain variation in a large set of variables, but again it is not satisfactory for tracing lines of causation. Econometric analysis is a marked improvement over these approaches.

The best way to explain econometrics briefly is to give a simple illustration. Suppose we know that among families in the United States, whenever disposable income per family member increases by one dollar, consumption expenditures per family member increase by ninety-three cents. Then an equation linking per capita consumer expenditures to per capita disposable income might be:

(2-1) $C = .93Y$

where C is defined as per capita consumption and Y as per capita disposable income. This equation is of course too simple as it now stands to be very useful. For one thing, we know that families with no income still make consumer expenditures by drawing on savings or by borrowing from friends or relatives. Thus, per capita expenditures might be as high as $500 per year even if income is zero. Thus, the equation might be rewritten as:

(2-2) $C = 500 + .93Y$

Many other improvements will quickly come to the mind of the reader, but let us delay implementing them for a moment.

Equation (2-2) traces a line of causation from income to consumption, but the values of 500 and .93 are conjectures plucked on the spur of the moment out of thin air. If we want to know what these values are in the "real world", how should we procede? As a start, we should of course interview a number of families and learn, as accurately as possible, how much the

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[1]The reader acquainted with least squares regression need not read this section in order to understand subsequent sections.

family earns after taxes, how much the family spends on consumer goods and services, and how many individuals are in the family. With this information, we could then graph the relationship between per capita expenditures and per capita income for the families in our sample. The graph, however, would not show all points along a single straight line as equation (2-2) implies. Instead, we would find a fairly regular cluster of points through which a straight line might be drawn, but a few points would lie well above the line, and some would lie much below it. The central task of econometrics is to try to isolate what regularity there is in such a scatter diagram and estimate the parameters of equation (2-2) from that regularity. For a simple equation such as (2-2) the statistical technique for isolating this regularity would be simple regression analysis, and the estimation procedure would be what is called ordinary least squares (OLS). In simple regression analysis, we specify an equation of the general form:

$$(2\text{-}3) \qquad C = a + bY$$

where C and Y are defined as above. Then, using the sample data collected from the families, we estimate the values of "a" and "b" in equation (2-3) by ordinary least squares through the solution of the following two equations:

$$(2\text{-}4) \qquad b = \Sigma(C - \bar{C})\ (Y - \bar{Y})/\Sigma(Y - \bar{Y})^2$$

$$(2\text{-}5) \qquad a = \bar{C} - b\bar{Y}$$

where C and Y are defined as above, and $\bar{C}$ and $\bar{Y}$ are the respective means for those two variables. These are called "ordinary least squares" estimates because for the line so defined by these values, the sum of the squared deviations from the points to the line will be smaller than the squared deviations summed about any other straight line drawn through the same scatter diagram.

The line of least squares, although the "best" line that can be fitted to the data, may or may not be a "good" fit. Goodness of fit is given by a coefficient called the coefficient of determination and symbolized as "r^2". The value of r^2 is 1.0 minus the ratio of the variation about the line to the variation about the mean of C. If there is no variation about the line, then all points in the scatter diagram lie on the line, and the value of r^2 is 1.0. In this case, the fit is said to be perfect. Similarly, if the value of r^2 is zero, then the fitted line contains no more information than the mean value of C.

Now, what about the improvements to equation (2-2) that came to the reader's mind a few paragraphs ago? It could be easily argued that wealth is also an important determinant of consumption as well as income. Then, if we were interested in the ultimate determinants of consumption, we might go on to argue that income is received both from wealth (the value of financial assets times the effective interest rate) and from expended labor (the number of hours worked times the wage rate). Moreover, the wage rate that a person could earn will be a function of his age, the number of years on the job, his level of education, the strength of his union (if any), the earnings of his employer, and so on. In other words, we are quickly moving from a single

equation econometric model to one with many equations, and in each equation there will be several variables on the right hand side. Variables that appear on the right hand side in some equations will appear on the left hand side in others. This is merely a way of saying that causation is simultaneous and not one sided.

When an econometric model has more than one equation with simultaneous causation, ordinary least squares is not generally a useful technique for estimating the parameters of the model. It is much better in these cases to select a technique that specifically takes account of the simultaneity among the variables. One such approach, and the one used in this study, is two-stage least squares (TSLS). Since the purpose of this chapter is simply to acquaint the reader with the techniques that will be employed below and not to write an econometrics text, we will not explain at this point how TSLS estimates are obtained. A discussion of this point and a brief elaboration of econometric techniques may be seen in Appendix A. At this point we will merely state that analogous to ordinary least squares, two-stage least squares is a statistical way of finding for a particular equation a numerical estimate of the effect of one variable on another.

In this study, we are interested in the use of econometric techniques to test hypotheses about the structure of the educational sector of the economy. The general approach may be described quite simply. Suppose after studying an area of economic behavior, we specify equations that precisely define all of the variables in that sector and suitably describe the behavioral relationships among the variables that we believe to exist. If logical analysis of these equations leads to a single equation or set of equations involving only observable variables, we may estimate the parameters in that equation via econometric methods. If the estimated values are close to the theoretical values implied by the behavioral equations, then the hypotheses implied are said to be accepted. Again, a simple illustration is in order.

Suppose we argue that consumers behave in such a way that they do not immediately adjust their consumption levels when their incomes change. Instead, we assert that they change it by a fraction of the difference between their old level of consumption and the level of consumption that will ultimately be justified by the new level of income. The equation that describes this type of behavior is:

$$(2\text{-}6) \qquad \Delta C = k(C^* - C_{t-1})$$

where ΔC is the change in consumption expenditures from one period to another, C^* is the level of consumption that is justified by the level of income, C_{t-1} is the level of consumption that existed in the previous period. We argue that the value of k should be between zero and unity. As equation (2-6) now stands, it cannot be estimated by econometric means since the value of C^* is not observable. However, we may assert another behavioral equation that describes desired levels of consumption to be a linear function of income, denoted as Y. Then:

$$(2\text{-}7) \qquad C^* = a + bY$$

Since it is not likely that consumers will increase consumption by more than changes in income, we might hypothecate that the value of b in equation (2-7) is also a positive fraction. Of course, this equation too cannot be estimated because of the unobserved variable C*. An estimable equation can be developed, however, by substituting equation (2-7) into equation (2-6) to yield:

$$(2.8) \qquad \Delta C = k(a + bY - C_{t-1})$$

or

$$(2\text{-}9) \qquad \Delta C = ka + kbY - kC_{t-1}$$

When the parameters of this equation are estimated by econometric techniques, the estimated coefficient for C_{t-1} will be the negative of k. For the hypotheses of the model to be accepted, this value must be a fraction. Moreover, the estimate of k must be so large relative to its standard deviation that we would conclude that in the "real world" the true value of k could not be zero. We may find the estimate of b by dividing the coefficient of Y by the estimated value of k. To accept the hypothesis regarding b, its estimate must be a fraction, and, again, large relative to its standard deviation. If both hypotheses are accepted and if equation (2-9) explains a large portion of the total variation in ΔC, then the theory describing this general area of behavior is said to be a good one.

With some variations, these will be the general methods employed in examining the hypotheses presented in the previous chapter.

A Model of the Educational Labor Market

As mentioned earlier, it is the purpose of this research to isolate and measure the effects of changes in the structure of the public educational sector on levels of output, costs, and revenues of that sector. In order to do this, it is necessary to study the functioning of the educational labor market and to see how that market responds to changes in the public educational sector. The reasons for this are simple. First, a complete description of the educational labor market will explain how the number of teachers and the wage rate for a given school district are determined. While it is perhaps impossible to measure clearly the output of a school district, we expect that it will vary directly with the number of teachers in that district, other things being held constant. Secondly, teacher salaries are the single most important component of costs for the average district. For example, in 1968-69, for 105 school districts enrolling more than 25,000 students, the salaries of the professional staff were 88.5% of total instructional costs, and total instructional costs were in turn 72.7% of total current expenditures for the same year. Since total teacher salaries equal the average wage times the number of teachers, it is important to know how each is determined.

Finally, the quality of the educational program should be closely related to the salaries paid to teachers in the long run. In a market type of economy,

wages serve as signals to prospective entrants into the labor market. As wages in one industry increase relative to wages in other industries, the number of people seeking to enter the higher paying industry will increase. If this is the case for teaching, a larger prospective labor force can result in a larger teacher-student ratio and, presumably, a "better" educational experience for the teacher. Moreover, a school district that pays a higher wage than other school districts in the same area will normally find that more teachers seek employment in that district than in other districts, other things being equal. From this large number of applicants, the district may pick those for employment who have the best credentials. Thus, even with the same teacher-student ratio, a district paying relatively higher wages might have a more capable teaching staff. Accordingly, the educational labor market is the key area of study for this project.

In order to study the educational labor market, we have concentrated on three different behavioral groups. First are the residents of the school district who must decide through some sort of elective process how much money to appropriate for the operation of the schools. Second is the school board which utilizes the revenues for hiring teachers, purchasing supplies, undertaking construction, and so on. Finally come the certified teachers who seek employment in the various districts. Each will be discussed in turn.

The Demand Equation. Residents in a given school district must ultimately decide how to spend their incomes among a wide array of goods and services that are presented to them.[2] Economists believe that the amount of their incomes that they are willing to devote to education depends on the unit price of education and its rate of return, as well as their total financial resources. Other variables probably include how closely the educational program of the district matches their own preferences, religious affiliation, the presence of parochial schools, and the prices of related goods. Unfortunately, data on many of these are not available for individual school districts, and school district boundaries and municipal boundaries did not give sufficient coincidence to use municipal data in our sample. Nonetheless, we were able to specify an equation for which data were available and which was suitable for exploring the central hypotheses of the research. As a measure of the amount of revenue appropriated by the community, we used local taxes and appropriations per student enrolled in the district. By expressing revenues on a per student basis, we hoped to avoid an artificially high value for the coefficient of determination that would normally come out of a regression of total revenues against total income. Moreover, deflating the revenue variable in this manner also forestalled a technical difficulty in statistics known as heterscedasticity. As an independent variable to measure financial resources of the community, we used total market value of property per enrolled student. Since most educational revenues came out of levies on property, we felt that this was the logical measure of financial means. Moreover, this variable incorporates the value of

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[2]Voter control of school finances need not be direct. The three most prominent forms of financial control are: a) election of an autonomous school board which determines expenditures and tax rates without a referendum; b) referendum for approval of a tax levy; c) presentation of a budget and an accompanying tax levy by the school board for a referendum. A breakdown of these schemes by state is given in Appendix B.

industrial property in the district whereas a variable such as median family earnings would not give any weight at all to the industrial tax base within the district.

A second variable included to explain taxes and appropriations per student was the percent of students in the district who were nonwhite. This variable is negatively correlated with financial resources, so we thought it might "pick up" any income effect not fully captured by the market property variable. In addition, it is positively correlated with population density, number of dilapidated dwelling units, and other variables that describe neighborhood conditions, each of which is likely to have some effect on the total amount of money forthcoming.

A third and final variable in the taxes and appropriations equation is the number of school districts in the same county as the district in question. This is indeed the focus variable for the entire study, and the reasons for its inclusion are fairly complex. We shall begin our explanation of the importance of this variable by again discussing some of the characteristics of a market economy.

In a market economy, the variety of goods that appear for sale will be in part a function of the number of suppliers of those goods. If there are several sellers of a differentiable good, each may try to enlarge his share of the market by offering a variation on the product. With several suppliers, the consumer thus stands a good chance of finding the basic good with just the right variations to satisfy his own desires. If there are very few sellers of a good, each seller will try to produce a product that appeals to the average consumer tastes, and variety will be limited. Harold Hotelling vividly illustrated this phenomenon by citing the similarities of the Republican and Democratic campaign platforms, then adding, "Methodist and Presbyterian churches are too much alike; cider is too homogeneous."[3]

Several years ago in a landmark article, Charles Tiebout pointed out that the same principle operates on the supply of services of local governments.[4] He pointed out that where there are many different governments in a metropolitan area, each may offer a somewhat different combination of public services. Therefore residents in the area are able to shop for the bundle of services most closely tailored to their own set of preferences and to choose their place of residence accordingly. Where there is but one government, residents may vote at the polls to try to promote that type of government service that they prefer, but they cannot vote "with their feet" by moving residences. Minorities will be unable to satisfy their special preferences for publicly provided goods.

If the Tiebout model is descriptive of real world behavior, we would expect that the residents in any one political subdivision of a multidivision community would tend to have similar tastes and preferences. Certainly the variation in tastes within a community would be less than within an entire metropolitan area. When tax levies are placed upon the ballot in such subdivisions, residents strongly identify with the proposed

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[3]Harold Hotelling, "Stability in Competition", Economic Journal, XXXIX (1929), pp. 41-57.

[4]Charles Tiebout, "A Pure Theory of Local Expenditures," Journal of Political Economy, LIV (October, 1956), pp. 416-424.

outlay because they believe that money raised by the levy will probably be spent in accordance with their wishes. Other things being equal, those residents would be more likely to vote for the levy than similar voters in a heterogeneous community. In the latter case voters might feel that on any given issue, their own preferences are those of the minority. The upshot of all of this is that the more communities in an area, or in the case at hand, the more school districts in an area, the greater will be the identification with and the support of the school system, other things held constant. Accordingly, we would expect the number of school districts to have a positive effect on local revenue per student.

There is yet another reason, similar to that given above, for expecting the number of school districts to have a positive effect on local school taxes and appropriations per student. This is because of its link with the distribution of income. The distribution of income among individuals is skewed to the right, so the mean level of income lies above the median which lies in turn above the mode. Let us assume that voters base their decisions on tax levies strictly on their own incomes, and further assume that the wealthier voters are willing to pay more than poorer voters. In the long run the level of educational expenditures that will result is determined by the median income of the city, since fifty percent of the voters would wish to pay less than that, and fifty percent would wish to pay more. If, however, the large city were broken up into many different municipalities, then each city would levy taxes in accordance with its own median income. Some of these medians would be above the area median, and some would be below. However, the average of the different medians would be very close to the area mean income, so the average level of taxes voted would be greater than before.[5]

The question to ask at this point is whether increasing the degree of political fragmentation in an area decreases the degree of income heterogeneity within the individual units. This topic has been researched thoroughly in previous research by Barbara Murray, who confirms that this is true.[6] The final implication is again that as the number of different school districts in an area increases, other things held constant, the financial support for education increases. While this may not be true for every district in the area because political fragmentation inevitably leads to some very poor districts, it should be true for all districts taken together.

Our model uses the natural logarithm of the number of school districts rather than the absolute number. This variable better takes account of the effects of political fragmentation in the local taxes and appropriations equation because changes in logarithms approximate percentage changes in their antilogs. If we had used the absolute number of school districts as the fragmentation variable, we would imply that a change from 1 to 3 districts would have the same effect as the change from 57 to 59. By using the logarithm, we imply that a change from 1 to 3 is the same in its effect

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[5]For support of this statement, see Robert Baird and John Landon, "Political Fragmentation, Income Distribution, and the Demand for Government Services", Nebraska Journal of Economics and Business XI (Autumn, 1972), pp. 171-184.

[6]Barbara P. Murray, "The Coefficient of Interarea Variation as a Measure of Metropolitan Spatial Income Inequality", Journal of the American Statistical Association, June, 1970, pp. 598-601.

as a change from 10 to 30. This is reasonable since the increases in homogeneity are likely to be smaller with each successive increment in the number of districts.

The final form of the tax equation can now be given as:

$$(2\text{-}10) \qquad R_1/S = a_o + a_1(M/S) + a_2N_1 + a_3L$$

where R_1 is local taxes and appropriations, S is the number of students enrolled in the district, M is the market value of taxable property in the district, N_1 is the percent of students in the district who are nonwhite, and L is the natural logarithm of the number of school districts in the same county. From the considerations given above, we would expect the estimated values of a_1 and a_3 to be positive and significantly different from zero, and the value of a_2 to be negative and significantly different from zero.

The Demand Equation. To represent the demand for teachers in the district, we have selected a stock adjustment type of equation. We believe that school boards cannot act immediately in response to changes in finances, costs, or unexpected enrollment shifts. Therefore, we stipulate that the number of new teachers added to (or subtracted from) a school district from one year to another will be a fraction of the difference of the number of teachers currently desired and the number that remains from the previous year. In equation form:

$$(2\text{-}11) \qquad \Delta T = k(T^* - T_{t-1}(1 - t))$$

where ΔT is the number of teachers added, T^* is the desired number of teachers, T_{t-1} is the number of teachers from the previous year, and t is the turnover rate for teachers in the previous year.

As explained in the previous section of this chapter, the value of T^* is unobservable. Thus, an equation to explain the desired number of teachers must be added. We first suggest that the desired number of teachers that a school district wishes will be the product of the district's desired teacher-to-student ratio and the number of its students. Expressed as an equation:

$$(2\text{-}12) \qquad T^* = (T/S)^*S$$

where $(T/S)^*$ is the desired teacher-to-student ratio. This equation has not removed the difficulty, only delayed it, since $(T/S)^*$ is also unobservable. To overcome this, we specify another equation that defines the desired teacher-to-student ratio. We argue that there is a certain minimal ratio that must be maintained, no matter what. Call this amount b_o. Then, more teachers can be added to this amount by hiring them from revenues available for that purpose. The number that will be added will be a fraction of the maximum number that could be hired, if all revenues were spent on teachers. Since most federal money to school districts is not directly used for hiring teachers, we have excluded this variable in calculating revenues

available for personnel. These revenues therefore include local taxes and appropriations plus revenue from state sources. The number of teachers that could be hired also depends on the wage rate, and we have selected the minimum salary paid to beginning teachers holding a bachelor's degree. We believe that this wage is the most important of the different steps in the salary schedule since it will be the wage considered by those prospective teachers who evaluate the trade-offs between employment as public school teachers and other occupations. Moreover, this wage is closely tied to all other salaries in the schedules of the school districts. For example, in 1968-69, the minimum salary for teachers holding master's degrees could be predicted by multiplying the beginning bachelor's salary by 1.09. This relationship accounted for eighty-five percent of the variation in the minimum master's salary. For the maximum salary for teacher's holding only a bachelor's degree, 1.47 times the minimum bachelor's salary explained sixty percent of the variation.

On the basis of these arguments, we have specified the desired teacher-to-student equation as:

$$(2\text{-}13) \qquad (T/S)^* = b_o + b_1 (R_1 + R_2)/W/S$$

where R_2 is revenue received by the district from state sources, W is the salary paid per year to beginning teachers holding only a bachelor's degree, and all other terms are as defined above. The hypothesis is that b_1 should be a positive fraction.

One theoretically appealing virtue of equation (2-13) is that it is homogeneous of degree zero in revenues and wages. This is to say that if total revenues were to double while the going wage rate also doubled, then the total teacher-to-student ratio would remain unchanged.

If equation (2-13) is substituted into equation (2-12), and the resulting equation substituted into equation (2-11), we have:

$$(2\text{-}14) \qquad \Delta T = kb_o S + kb_1 (R_1 + R_2)/W - kT_{t-1}(1 - t)$$

where all terms are as given above. When this equation is estimated, we expect the value of k to be a positive fraction.

The Supply Schedule. With equations for local revenue and the demand for teachers specified, we need now consider those variables that cause teachers to seek employment in one school district as opposed to another. The greatest single force is of course the size of the district. A district with one million inhabitants will have a larger potential teaching force living in it than will a city of eighty thousand. The logical choice of a variable to measure size would seem to be population, but population by school district was not available and, as stated above, municipal data did not seem to serve as a good proxy. As a result, we used the number of students in the district as the measure of school district size.

A second explanatory variable in this equation is the number of nonwhite students in the district. The obvious linking factor here is prejudice, so we anticipate that the coefficient of this variable would be negative. Moreover the negative influence will be strengthened by the extent to which this variable measures deteriorated neighborhoods. To measure the opportunity

cost of seeking employment as a teacher, we have selected the median professional earnings in the same county. We believe that this variable represents the salaries received by people with approximately the same training as teachers and thus is an indication of the money that teachers must forego to become a teacher. Other things being equal, an increase in the opportunity cost makes it more costly to be a teacher, so we would expect that this variable will have a negative effect on the number of teachers supplied to a district.

The most important variable in the supply equation is related to the salary paid to teachers. Traditional theory about labor markets argues that other things held constant, an increase in the wage should increase the number of teachers supplied. However, the response of the number of teachers supplied to any given change in the wage rate should depend on the number of districts in the labor market that are competing for teachers' services. As Baird and Landon have stated:

> The availability of alternative employment within the teaching profession at the local level strongly influences the responsiveness of the labor supply to a given change in compensation. ... The presence of other school districts in the area increases the number of options available to the teacher without requiring a change of residence.[7]

In order to blend together the wage rate and the effective competition in the area, we have selected as a variable the product of the beginning salary and 1.0 plus the logarithm of the number of districts in the area, or $W(1.0 + L)$. Notice that if the district in question is the only district in the county, this variable becomes merely the wage rate, W. In that case, a district has no effective competitors, and to increase the number of teachers supplied to it, it must increase its own wage offering to offset the opportunity cost of seeking employment in a different profession. However, if the number of competitors is large, the variable becomes W multiplied by a significant positive constant. If the district then raises its wage, it will not only induce some teachers to leave alternative professions, but it will also cause teachers to leave other school systems in the same area. We believe that this is a reasonable description of long run behavior.

Finally, the number of competitors in an area may affect the entire number of teachers supplied to a given district, as well as the responsiveness to the wage rate. To allow for this possibility, we have added as a separate variable in the equation the natural logarithm of the number of school districts in the county.

The final form of the supply equation is therefore:

$$(2\text{-}15) \qquad T = c_0 + c_1 S + c_2 N_2 + c_3 P + c_4 W(1 + L) + c_5 L$$

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[7] John Landon and Robert Baird, "Monopsony in the Market for Public School Teachers", American Economic Review, LXI (December, 1971), pp. 966-71.

where P is median professional earnings and N_2 is the number of nonwhite students. Because the number of teachers and the number of students are so highly correlated, the attempt to estimate this equation would probably be fruitless. The relationship between those two variables would simply overwhelm any other relationships that might be present. We therefore divided both sides of equation (2-15) by S and estimated the supply equation as the teacher-to-student ratio:

$$(2\text{-}16) \qquad T/S = c_o(1/S) + c_1 + c_2N_1 + c_3P/S + c_4W(1 + L)/S + c_5L/S$$

where all variables are as defined above.

The Complete Model. The three equations together appear as:

$$(2\text{-}10) \qquad R_1/S = a_o + a_1(M/S) + a_2N_1 + a_2L$$

$$(2\text{-}14) \qquad \Delta T = kb_oS + kb_1(R_1 + R_2)W - kT_{t-1}(1 - t)$$

$$(2\text{-}16) \qquad T/S = c_o(1/S) + c_1 + c_2N_1 + c_3P/S + c_4W(1 + L)/S + C_5L/S$$

When these equations are estimated by the process of two-stage least squares, we expect to obtain negative coefficients for a_2, $-k$, c_2, c_3, and c_5. For the others, we expect positive coefficients, with a_2, b_1, and c_4 being those to which we attribute the greatest importance.

As given by these three equations, the labor market model contains eleven different variables. Of these, the values of three of them, R_1 T, and W, are to be determined by the interplay of forces described by the model. These variables are said to be endogenous. The remaining variables are determined by political and social variables outside the scope of the model and are said to be exogenous to the model. An important part of every econometric model is to show how endogenous variables are affected by changes in exogenous variables once the effects of these changes have been allowed to work their way through the entire system. Frequently, these changes cannot be deduced simply from an inspection of the estimated coefficients. For example, we anticipate that an increase in the percent nonwhite students in a district will decrease revenues per student and therefore reduce the demand for teachers. This would have the effect of lowering the wage rate. On the other hand, an increase in the number of nonwhite students will probably reduce the number of teachers supplied to the district, which would tend to increase wages. The net result of these two different forces could not be simply discerned.

The solution to this problem is provided by a set of mathematical techniques that allows us to express any change in an endogenous variable as a function of a change in the exogenous variables in the system. While these techniques are too technical to be described here, they are commonly

employed in much current economic research involving simultaneous equations.[8] Use of these techniques will help us show how educational reforms that affect the structure of the educational market will feedback to affect outputs and revenues in that market.

[8]The techniques mentioned here involve the use of Cramer's rule to solve simultaneous equations. For a good description, see R.G.D. Allen, Mathematical Analysis for Economists, (New York: St. Martin's Press, 1933), Ch.

CHAPTER 3

RESULTS

This chapter presents the results obtained by estimating the equations described in Chapter 2. Part I contains a discussion of the estimates for each of the equations in the model of the educational labor market. Part II examines the interactions within the model, and Part III considers the reasonability of the estimates. Part IV reviews additional findings related to the central issues of the research.

Equations of the Educational Labor Market

The Revenue Equation. As explained in Chapter 2, the form of the revenue equation is:

$$(2\text{-}10) \qquad R_1/S = a_o + a_1(M/S) + a_2N_1 + a_3L$$

Application of the two-stage least squares estimation technique yielded the following estimates (figures in parentheses are the estimated standard deviations of the estimates):

$$(3\text{-}1) \qquad R_1/S = 82.998 + \underset{(.00375)}{.00929}(M/S) - \underset{(0.575)}{1.74}N_1 + \underset{(7.16)}{14.36}L$$

$$R^2 = .865$$

All of these estimated coefficients are significantly different from zero at the .025 level, using a two-tailed "t" test.[1]

The data used to fit this equation are scaled in their natural units, so an increase in market value of property per student of $10,000 would imply, other thing held constant, an increase in taxes and appropriations per student of about ninety-three dollars. Similarly, each unit increase in the percent of students who are nonwhite is associated with a decrease in revenue per student of one dollar and seventy-four cents. The coefficient of the natural logarithm of the number of school districts indicates that each unit increase in that variable was accompanied by an average increase in local taxes and appropriations per student of fourteen dollars and thirty-six cents. Each coefficient has the sign predicted by the theoretical arguments in Chapter 2, and the three independent variables together account for over eighty-six percent of the variation in the dependent variable.

The Demand Equation. The form of the demand equation given in Chapter 2 is:

$$(2\text{-}14) \qquad T = kb_oS + kb_1(R_1 + R_2)/W - kT_{y-1}(1 - t)$$

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[1] For two-stage least squares, the ratio of a coefficient to its standard error asymtotically approaches the "t" distribution.

The estimated parameters when fitted into this equation yield:

$$(3\text{-}2) \qquad T = .00347S + .0647380(R_1 + R_2)/W - .267403T_{t-1}$$

$$(.002039) \quad (.0091365) \qquad (.051512)$$

The coefficient for the number of students enrolled is significant at the .05 level, and the other rwo are significant at at least the .025 level. Each coefficient again has the sign predicted in Chapter 2, and the values for k and b_1 are both fractions, again as predicted by the theory.

Some adjustments, however, are required in estimating the value of k. As shown in equation (3-2), the last term on the right hand side is T_{t-1}, whereas the last term in equation (2-14) is $T_{t-1}(1-t)$. Because data on turnover rates by district are not available for the year 1968-69, we were not able to estimate the equation as given by (2-14). Accordingly, the value of the coefficient measures not only the value k, but also the turnover rate for the districts. If we take the average rate of turnover for 1967-68, 17%, then the term (1 - t) equals .83. In that case, from equation (3-2), we have:

$$(3\text{-}3) \qquad .267403 = k(1-t) = k(.83)$$

or:

$$(3\text{-}4) \qquad k = .267403/.83 = .322$$

The value of k in this type of equation is generally referred to as the "speed of adjustment" since it indicates how rapidly a response develops to a surplus or deficit. A speed of adjustment in this case of .322 states, for example, that if a deficiency of teachers develops, the average school district will attempt to make up 32.2 percent of that deficiency within one year. If such a district were 100 teachers shy of its desired level, it would hire about thirty-two teachers in that year.

The second variable on the right-hand side of equation (3-2) measures the number of beginning teachers that could be hired if all local and state revenues were devoted to that purpose. The estimated coefficient states that for every one teacher that could be hired, one-sixteenth of a teacher will be hired. Perhaps a better way of looking at this relationship is to examine the reciprocal of that coefficient, which is 15.45. The interpretation is now that an increase of revenues sufficient to hire fifteen and one-half new teachers will actually lead to the hiring of one new teacher within one year, other things held constant.

The coefficient for the number of students enrolled is .003473, and its reciprocal is 287.94. In other words, an increase of 288 students, other things held constant, will be associated with an increase in the teaching staff by one within one year.

The coefficients from equation (3-2) can be used to calculate the coefficients in the equation defining the desired number of teachers in the district. As given in Chapter 2, that equation is:

$$(3\text{-}5) \qquad T^* = b_0 S + b_1(R_1 + R_2)/W$$

Because the first two coefficients on the right hand side of equation (3-2) were kb_o and kb_1, we need only divide those coefficients by k to derive estimates of b_o and b_1.

(3-6) $b_o = .003473/k = .003473/ .322 = .0108$

(3-7) $b_1 = .064738/k = .064738/ .322 = .201$

Whereas the coefficients in equation (3-2) measure changes that might occur within one year, the coefficients calculated in equations (3-6) and (3-7) are said to measure "long-run" effects. That is, they show the effects of changing enrollments, revenues, and wages once the initial surplus or deficiency in the teaching staff created by those changes is eliminated by many periods of adjustment. Reciprocals of these coefficients are, respectively. 93.5 and 4.98. Thus, in the long run, and increase of ninety-four students is associated with the hiring of one new teacher, and an increase in revenues enabling the hiring of five beginning teachers will actually lead to the hiring of one new teacher. Both effects of course assume that other variables are held constant.

The Supply Equation. The form of the supply equation is:

(2-16) $$T/S = c_o(1/S) + c_1 + c_2N_1 + c_3P/S + c_4W(1+L) + c_5L/S$$

The equation estimated by the two-stage process is:

(3-8) $$T/S = \underset{(438.62)}{-2071.9(1/S)} + .03443 - \underset{(.000072)}{.0001825N_1}$$

$$\underset{(.10599)}{-.76004P/S} + \underset{(.18307)}{2.08019(1+L)W/A} - \underset{(1161.94)}{13532.08L/S}$$

All coefficients are significantly different from zero at the 0.01 level, and each coefficient carries the theoretically correct sign.

When equation (3-8) is multiplied through by S, we have:

(3-9) $$T = -2071.9 + o3443S - .0001825N_2 - .7600P$$

$$+ 2.08019(1+L)W - 13532.08L$$

The coefficient in equation (3-9) that is of greatest importance for this project is the one multiplying (1+L)W. This coefficient shows the responsiveness of the number of teachers supplied to the wage rate. Expressed in this form, it shows that the responsiveness increases as the number of competing school districts increases. For example, if there is only one district in the county, then L is zero, and the entire term would equal 2.08019W. In that case, an increase in the minimum wage of one dollar would be associated with an increase of two in the number of teachers supplied. On the other hand, if there were fifty districts in the same area, then L would equal 3.912 and the whole term would be 10.218. Under these conditions, an increase in the wage rate by one dollar would be associated with an increase of ten in the number of teachers supplied.

Each of the other coefficients in the equation is self-explanatory. It may be interesting to note that the reciprocal of the coefficient for number of students nonwhite (N_2) is 5479, implying that an increase of that many nonwhite students would lead to a reduction of one in the number of teachers supplied. Along the same line, the reciprocal of the median earnings variable (P) is 1.3157, which indicates that a one dollar and thirty cent increase in the opportunity cost of teaching will reduce the number of teachers supplied by one, other things held constant.

The Complete Model

While each of the above equations is useful for understanding how the educational labor market operates, it is nonetheless essential to fit the equations together to see how any single change works its way through the system. We do this by first assuming that the quantity of teachers demanded equals the quantity of teachers supplied. Then, the three equations could be solved simultaneously to yield values for local appropriations, number of teachers, and beginning wage rates that "clear" the market. Rather than follow this procedure, however, we prefer first to take the total differentials of each equation. Then, using Cramer's rule, we solve the three differential expressions to develop equations giving values of the differentials of the endogenous variables as functions of the differentials of the exogenous variables. From these equations, it is then but a simple step to find the derivative of any single endogenous variable as a function of any single exogenous variable. A derivative, of course, is nothing more than the rate at which one variable changes per unit change in another variable.

As an example of how a change in one of the exogenous variables works its way through the system, consider what might happen in response to an increase in the percentage of total enrollment that is nonwhite. From the revenue equation, we see that local taxes and appropriations should decrease in response. With lower total revenues, the number of teachers that the district can hire is decreased, and the total demand for teachers falls. Other things held constant, a decrease in demand will normally lead to lower wages and smaller quantities hired. However, other things could not be held constant in this case because the percent of students who are nonwhite also affects the supply equation. As the percent nonwhite increases, the number of teachers offering their services to the school district decreases. This effect, by itself, would tend to raise wage rates and lower the number of teachers. The combined effects of the reduced demand and the reduced supply can be seen immediately in terms of the number of teachers hired, since each individual effect is to decrease that number. The effect on the wage rate is not clear because the forces work in opposite directions on this variable. Hence the need to calculate the derivative of the wage rate with respect to the percent nonwhite.

The derivatives of importance to this project are given in Table 2-1. Rather than write the derivatives as long functions of the exogenous variables in the model, we have chosen to evaluate the derivatives at the mean values of the variables for the one-hundred and five districts in the sample. Each numerical entry in the table is the derivative of the variable given at the top of the column with respect to the variable given at the left side of the row. Thus, the derivative of the beginning wage rate with respect to

the percentage of enrollment that is nonwhite is 2.005. With the exception of market value of property and revenue from state sources, the variables are scaled in the same units as for the equations discussed so far. We changed to millions of dollars as the unit of measurement of these other two variables to reduce the size of the numbers carried in the table.

The numbers in the table contain the following implications for a school district having the mean attributes of the one-hundred and five districts studied:

1. An increase of one million dollars in market value of property would increase local school taxes and appropriations by $9294, increase the beginning wage rate by $.016, and increase the number of teachers by .0984.
2. An increase of one in the logarithm of the number of districts would lead to an increase in local revenues and appropriations of $1096700, an increase in the beginning wage of $159.65, and a decrease in the number of teachers by 1.87.
3. An increase in the nonwhite enrollment by one percentage point would lead to a decrease in local taxes and appropriations by $132890, an increase in the wage rate of $2.005, and a decrease in the number of teachers by 1.60.
4. If the number of teachers employed last year had been one greater than the actual count, then this year's wage rate would have been lower by $.0428, and the number of teachers employed this year would be smaller by 0.26.
5. An increase of one million dollars in revenue obtained from state sources would increase the wage rate by $1.72 and increase the number of teachers by 10.59.
6. An increase in median professional income in the county by one dollar would raise the wage rate for beginning teachers by $.12 and decrease the number of teachers by .01.

These results should be taken as an illustration of the effects of changes in one of the exogenous variables on the endogenous variables and not viewed as predictions of actual outcomes. The effect on any given school district of one of these changes will depend on many additional variables not included in this study, such as the competence of the local school board, the unique tastes and preferences of the residents of the community, previous experience in dealing with change, and many other factors. There is little doubt, however, that the directions these effects will take will be those described above. The hypotheses implied by the theory of Chapter 2 are confirmed.

Is The Model Reasonable?

The figures presented in Table 3-1 are the best estimates that we can offer for the effects of changes in the exogenous variables on the three endogenous variables. Moreover, the fact that the estimated coefficients in the three equations are large relative to their estimated standard deviations causes us to think that our best estimates are also good estimates. In this section, we seek to add support to this assertion by considering additional evidence on the reasonability of the model.

First, probably the best indicator that the estimates of the various relationships are good ones is the fact that they all seem reasonable at

TABLE 3-1

DERIVATIVES OF THE LABOR MARKET MODEL

Exogenous Variables	Endogenous Variables		
	Local Taxes, Appropriations (R_1)	Beginning Wage (W)	Number of Teachers (T)
Market Value (M) (In $ millions)	9294.0	.016	.0984
Log of Districts (L)	1096700.0	159.65	-1.8735
% nonwhite enrollment (N_1)	-132890.0	2.005	-1.5976
Teachers in previous year, (T_{t-1})		-.0428	-.26374
Revenue from state sources, (R_2)		1.7199	10.586
Median professional income, (P)		.12180	-.0104

the intuitive level. That is, when we argue that an increase in the opportunity cost of teaching by one dollar will ultimately increase the wage rate by twelve cents, we do not insult common sense. If the final effect on the wage rate had been an increase of five dollars or a reduction of one dollar, we would have been provoked to say that the result was nonsense. No such provocations occur for any of the estimates in the model.

Secondly, our confidence in the reliability of the estimates is further increased because these estimates compare closely with similar estimates in related studies. For example, R.G. Ehrenberg, writing in a recent issue of the American Economic Review[1] estimated that the short-run elasticity of the demand for educational employees by state and local governments with respect to the educational wage rate was -.175. This elasticity measures the percentage change in the number of employees that will be demanded in response to a one percent change in the wage rate. Although such an estimate is not an immediate output from our demand equation, one can be calculated. The formula for this elasticity is:

$$(3\text{-}10) \qquad E_{t,w} = (dT/dW)\ (W/T)$$

where $E_{t,W}$ represents the elasticity of the number of teachers with respect to the wage rate, and dT/dW is the derivative of the number of teachers with respect to the wage rate. Taking the derivative from equation (3-2), we have:

$$(3\text{-}11) \qquad E_{t,w} = -W/T(R_1 + R_2)\ .064738/W^2$$

If we evaluate this expression at the mean values of the variables involved, we get:

$$(3\text{-}12) \qquad E_{t,w} = -.1725$$

In other words, a one percent increase in the going wage rate will decrease the number of teachers demanded within one year by .1725 percent. This is so close to Ehrenberg's estimate that no comment is needed. The long run estimate of the elasticity can be obtained by dividing the short run estimate by the speed of adjustment, .322. This gives a long run elasticity of -.536. Ehrenberg does not give a point estimate for the long run elasticity, but his interval estimate for this figure is -.09 to -.57. Our figure is within this range, although very close to the upper bound. On the basis of these comparisons, we conclude that the demand equation of our model is consistent with the findings of other researchers.

It is more difficult to compare our supply equation with others because of the paucity of research in this area. Robert Thornton[2] specified a supply equation in his paper, but he developed estimates only for the parameters of one reduced form equation, and separate estimates are not available for

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[1] R.G. Ehrenbert, "The Demand for State and Local Government Employees", American Economic Review, LXIII (June, 1973), pp. 366-379.

[2] Robert Thornton, "The Effects of Collective Negotiations on Teachers' Salaries, Quarterly Review of Economics and Business, XI (Winter, 1971), pp. 36-46.

the parameters of the individual equations of his model. Moreover, he has specified a redundant equation in his model, so the reduced form estimates are not to be trusted. Eric Toder[3] has recently published a paper dealing with the supply schedules for public teachers, and it is possible to make some comparisons of his equation to ours.

Toder's supply equation is distinctly different in form from the one in this report. First, he is dealing with only Massachusetts school districts. Secondly, he assumes that these districts participate in a perfectly competitive labor market. Finally, as a consequence of these, he concludes that the wage rate is perfectly inelastic with respect to the number of teachers hired, or, in other words, that a district can hire as many teachers as it wishes at the going rate of pay. The observable differences in wages that exist among districts are caused by differences in age, education, and seniority of the faculties as well as of the working conditions in the district and the opportunity cost of teaching. We were able to make a comparison of his results to ours on the effect of a change in the opportunity cost variable.

In Toder's equation, an increase in median family income increases the going wage by twelve cents. This is exactly the figure that we get from Table 3-1 for a change in median professional earnings in the county. Again, the closeness of the estimates is remarkable. The percent of students nonwhite is a variable in both Toder's paper and in ours, but no simple comparison is possible here. Toder indicated that a one percent increase in the percent nonwhite would raise the supply schedule by twenty-six dollars. Our Table 3-1 shows that a one percent increase in the percent nonwhite is associated with an increased beginning wage of only two dollars. However, in our model, the percent nonwhite is a variable that appears on both the supply side and the demand side. Whereas Toder is measuring only the premium that teachers may demand to teach in nonwhite districts, we are measuring both this premium and the decreased ability to pay for teachers in nonwhite districts. Since these two partially offset each other, it is logical that our net figure should be lower than the twenty-six dollar figure of Toder's but, little more than that can be said Nonetheless, it is important to note that our results are not inconsistent. with his.

On the basis of these comparisons we conclude that our model of the educational labor market is a reasonable one.

Related Findings

The previous portions of this chapter offer the results for the major portion of this research. This section concentrates on additional matters discussed in the proposal.

Tax Regressivity. One of the related areas discussed in the proposal concerns the rate structure of taxation. Taxes are said to be regressive if

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[3] Eric J. Toder, "The Supply of Public School Teachers to an Urban Metropolitan Area: A Possible Source of Discrimination in Education", Review of Economics and Statistics, LIV (November, 1972), pp. 439-443.

the rate declines as the tax base increases; proportionate if the rate is constant for all values of the base; and progressive if the rate increases as the base increases. We wish to consider whether the type of rate structure affects the amount of revenues that are forthcoming. Since many proposals for educational reform urge the abandonment of reliance upon property taxes, this is an important issue. Unfortunately, it is also very complex.

Suppose each taxpayer behaves selfishly and attempts as much as possible to put the burden of tax revenues onto other taxpayers. What type of tax structure might then be developed? To address this question, let us assume that income, X, follows the probability function f(X). Most typically, empirical distributions of the distribution of income are skewed to the right so that the mean of the distribution, μ, is greater than the median, M. We assume that this is true for f(X). A progressive tax on income that could be developed might have the following formula:

$$R_1(X) = b_1 + b_2(X - M) \tag{3-13}$$

where $R_1(X)$ is the tax rate paid by a person receiving \$X of income, M is the median income received, and b_1 and b_2 are positive constants. For the recipient of the median income, X equals M, so his tax rate is b_1. For incomes greater than M, X - M is positive, and the rate of taxation is greater than it is on the median income. For incomes less than the median, the tax rate will be less than it is on the median. Thus, as income increases, the tax rate increases, and the rate structure is progressive. The total revenues from this tax will be:

$$Y_1 = \int_0^{X\ \text{Max.}} (b_1 + b_2(X - M)\ Xf(X)dX \tag{3-14}$$

where Y_1 is total tax receipts from the progressive tax. Integration yields:

$$Y_1 = b_1\mu - b_2M\mu + b_2K \tag{3-15}$$

where K is the expected value of X^2.

Next, consider a regressive tax structure where the rate of tax regressivity is the same as the rate of tax progressivity given by equation (3-13).

$$R_2(X) = c_1 + b_2(M - X) \tag{3-16}$$

For equation (3-16), a one dollar increase in income decreases the tax rate by b_2, whereas a one dollar increase in income for equation (3-13) increases the tax rate by b_2. This is what is meant by equating the rates of tax progressivity and regressivity. The revenue yielded by the regressive system could be shown to be:

$$Y_2 = c_1\mu = b_2M\mu - b_2K \tag{3-17}$$

Finally, suppose that the two different tax systems were to yield the same amount of total revenues, so $Y_1 = Y_2$. Then:

(3-18) $$b_1\mu - b_2M\mu + b_2K = c_1\mu + b_2M\mu - b_2K$$

or

(3-19) $$b_1\mu = 2b_2(M\mu - K) + c_1\mu$$

For a distribution that is skewed to the right, it can be shown that:

(3-20) $$M\mu - K < 0$$

Therefore, since b_2 is positive,

(3-21) $$b_1\mu > c_1\mu$$

and

(3-22) $$b_1 > c_1$$

In other words, if a community of taxpayers was given a choice between a regressive system of taxation and a progressive system of equal tax yield, and if the rates of regressivity and progressivity were equal, then the rate of taxation applied to the recipient of the median income would be lower under the progressive system. If voters were motivated purely by selfishness, they would choose the progressive system. While this result is proved for only one very narrow set of tax systems, it can be expanded to more general characteristics. We seek here only to show a preference for progressive taxation, other things held constant.

Of course, selfishness is not the only motivation for taxpayers. People are also driven by considerations of "fair play" and other virtues. Accordingly, society has often collectively decided that the wealthy should assume a disproportionately large share of the tax load to relieve the financial burdens of the lower income classes. A progressive tax system is an avowed goal of most proposals for tax relief simply on the basis of fairness. This is one case where tendencies toward altruism and selfishness tend to reinforce each other.

If our discussions above are correct, a shift from regressive tax programs to progressive tax structures in the educational sector should increase the amount of revenue forthcoming. There is no suitable way to test this hypothesis for the educational sector alone since detailed data are not available on effective rates of tax progression for educational tax data. However, there are data on rates of regressivity for state and local tax systems taken as a whole.[4] Table 3-2 shows estimated effective tax rates by income classes for 3 different state and local taxes. As is clearly indicated, the income tax shows strong rate progressivity, with the rate in the highest income class fourteen times as large as the rate in the second

[4]These rates are effective rates in terms of income as a base. The property and sales tax rates are proportionate when compared to their nominal bases.

lowest class. On the other hand, both sales taxes and property taxes exhibit significant regressivity. Moreover, the rate of regressivity is very similar, with the ratio of the rates in the lowest and highest income classes being 6.0 for the property tax, and 7.1 for the sales tax.

On the basis of these arguments, we expect that state and local governments which rely primarily on property or sales taxes should have lower levels of government expenditure per capita than states which rely more heavily upon income taxation, other things being equal. Accordingly, we estimated the following regression equation:

$$(3\text{-}23) \qquad Y = a + b_1P_1 + b_2P_2 + b_3P_3 + b4P_4 + b_5X_1 + b_6X_2 + b_7X_3$$

X_1 is per capita income in the state, X_2 is the percent of the state population living in urban places, and X_3 is the population density of the state. P_1, P_2, P_3, and P_4 are, respectively, the percentages of state and local revenue derived from property taxes, income taxes, sales taxes, and other taxes. Y is state and local government expenditures per capita. The first three variables are included because they have been more or less traditionally recognized determinants of state and local government expenditures since the pioneering work of Solomon Fabricant.[5] The remaining four variables are focus variables for this section. Our arguments above suggest that the regression coefficients for P_1 and P_3 should be negative because the variables are regressive types of taxation. In absolute value, the coefficients should be about equal. The regression coefficient for P_2 should be positive.

Ordinary least squares estimates of these parameters based on data for 1970 are found in Table 3-3. As the table shows, our hypothesis that the property and sales tax percentages would have negative coefficients of about equal magnitude is confirmed. Our hypothesis that the income tax should have a positive sign is not confirmed. This latter result is not without explanation, however. We phrased our earlier discussions in terms of which types of taxes are relatively more desirable. We should have not assumed that this implies that any single tax might be absolutely desirable. The fact that the coefficient on the income tax variable is in absolute value only two-thirds as large as the sales and property tax variables supports our argument that reliance on progressive taxation will be relatively more expansionary than reliance on regressive taxation. The fact that the coefficients for all the tax variables are negative may simply mean that voters find any taxation distasteful.

Our conclusion is that a shift of educational finance programs from the regressive property tax to more progressive tax structures would increase the long run financial support of the schools.

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[5] Solomon Fabricant, The Trend of Government Activity in the United States since 1900 (New York: National Bureau of Economic Research, 1952).

TABLE 3-2

STATE AND LOCAL TAXES AS A PERCENT OF INCOME, 1965, BY INCOME CLASS

Type of Tax 2/	Total	Under $2000	$2000-$3999	$4000-$5999	$6000-$7999	$8000-$9999	$10,000-$14,999	$15,000 +
State & Local Taxes	9.0	25.1	11.0	9.8	8.9	9.2	8.6	6.8
Excise & Sales	2.8]	10.7	3.3	2.9	2.7	3.1	3.1	1.5
Property	4.2	13.2	6.3	5.3	4.6	4.5	3.8	2.2
Personal Income	.8	0	.1	.2	.4	.6	.8	1.4

Taken from David J. Ott, "Background and Basic Assumptions of Tax-Transfer Chart Data," report prepared for Council of Economic Advisers, 1969. (mimeo)

TABLE 3-3

REGRESSION COEFFICIENTS AND RELATED DATA

Dependent Variable: State and Local Government Expenditures Per Capita

Independent Variable	Coefficient	Standard Error
P_1, % Revenue from Property Taxes	-12.72	3.22
P_2, % Revenue from Income Taxes	-7.97	3.57
P_3, % Revenue from Sales Taxes	-12.19	3.42
P_4, % Revenue from Other Taxes	-11.74	5.11
X_1, Per Capita Income	.257	.035
X_2, Percent Urban	-.129	.083
X_3, Population Density	-1.89	1.35
R^2 = .695		
Constant =		

The Distribution of Income. We hypothesized in our original proposal that:

> With a given number of school districts in an area, an increase in the skewness of the income distribution will decrease educational expenditures per student.

We believe that this result is supported by the research results cited thus far. We have shown in the analysis of tax rate structures that an increase in the skewness of the income distribution decreases the desirability of regressive tax structures. Since most educational finance programs are currently based on regressive property taxes, this implies that an increase in skewness would decrease the desirability of increasing educational expenditures. Moreover, an increase in skewness, other things held constant, would reduce the homogeneity of tastes and preferences within individual communities, and, by the forces cited in Chapter 2, reduce voter support of educational finance programs.

A separate test of the effect of changing the distribution of income proved to be very difficult. For the individual school districts, we were unable to get a measure of the distribution of income. However, for 1967 we found 89 large counties containing only independent school districts for which we were able to develop two measures of the distribution of income. One is the sum of the percentage of households in the county earning less than $5,000 per year and the percentage earning more than $15,000. The other is a Gini coefficient fitted to Adjusted Gross Income data published by the Internal Revenue Service. This coefficient ranges between zero and unity, with those respective extremes designating perfect equality and perfect inequality of the distribution of income.

These two variables were used in two multiple regression equations along with other important explanatory variables. In the first equation, the dependent variable was total educational expenditures per capita in the county; in the second, total educational expenditures per student. If our theory is correct, the regression coefficients for both of the income variation variables should be negative. The more widely scattered is income, the greater the difficulty of having homogeneous schools, and the smaller will be the support of the school systems. Results of the regression are given in Table 3-4.

The data in the table fail to confirm these arguments. The sign of the sum of the percentages variable is in the right direction, but the coefficient is not significantly different from zero. The coefficient for the Gini variable is also insignificant, and its sign is not in the hypothecated direction. The coefficient of the logarithm of the number of school districts is significant and positive, so this variable may be poking up the influence on income variation in the manner described in Chapter 2. However, it is best merely to state that the results do not give the anticipated results rather than to seek a statistical alibi.

Private School Enrollment. We stated in our proposal that a change in the range of choices in the public educational sector should affect the enrollment in the private educational sector. Specifically, we wrote that, "Consolidation of school districts or even an increase in uniformity of curricula among school districts might cause some families to shift to

private schools that offer programs more highly tailored to their tastes." We were unable to complete this test for lack of data. A controlled experiment involving private school enrollment should include a set of control variables for religious affiliations in the area. We were not able to develop even the broadest categories of data for political boundaries as large as a county. Since we were unable to control for what we thought was the most important single variable, we obtained no useful results.

TABLE 3-4

REGRESSION COEFFICIENTS AND RELATED DATA

Dependent Variables: Educational Expenditures by County

	Per Capita		Per Pupil	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Op. Density	-.014	.019	.149	.104
Sum of %'s	-.042	.068	-.419	.358
GINI	.149	.125	.758	.635
Area of County	.004	.023	.019	.115
Avg. School District Population	.100	.038	.635	.196
Income Per Capita	.127	.050	.450	.557
State Aid Per Capita	.046	.007	.046	.008
Log of Districts	.131	.044	.717	.225
Constant	-12.08		28.70	
R^2	.524			.612

CHAPTER 4

CONCLUSIONS

From the material presented in the previous chapters, we conclude that the market structure of the educational sector is an important variable affecting the performance of that sector. Any restructuring of local educational markets will influence total educational revenues, wage rates for teachers, and the number of teachers employed. For many proposed reforms, our research indicates that such changes would work against the attainment of the avowed goals of the proposal.

It is the purpose of this chapter to evaluate the more popular of current educational reform proposals in view of our research findings. While we offer support for some of these, this should not be taken as an across-the-board endorsement. Our only criterion for judgment is the impact on market structure.[1] We are not professionally qualified to consider dimensions of quality that go beyond spending levels, teacher-to-student ratios, and relative wage rates.

We will consider four specific types of proposals that have been discussed widely enough in the literature to be of general interest. The specifics of these proposals vary from author to author, but all focus on the method of control. For our study, the two most important variables to be controlled are taxation and expenditure. Taxation changes may include:

1. the type of taxation (income, sales, property, value added, wealth, etc.)
2. the level on which the tax is levied (school district, county, state, etc.)
3. the institutions through which the tax level is approved (direct vote, election of board members, approval of a budget, etc.)

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[1] For a more thorough discussion of the various reform proposals we suggest the following sources: John E. Coons, William H. Clune III, and Stephen D. Sugarman, Private Wealth and Public Education, Cambridge: Harvard University Press, 1970; Arthur E. Wise, Rich Schools, Poor Schools: The Promise of Equal Educational Opportunity, Chicago: The University of Chicago Press, 1968; Stefan Michelson and Norton Grubb, The Political Economy of School Resource Inequalities; National Educational Finance Project, "Future Directions for School Financing," Gainsville, Fla.: 1971; James B. Conant, "Full State Funding," in Financing Public Schools, Federal Reserve Bank of Boston (Conference Series No. 7) January 1972; Christopher Jenks, et. al., Inequality: A Reassessment of the Effect of Family and Schooling in America, New York: 1972; Charles S. Benson, "State Assumption of Educational Costs," National Tax Association, Proceedings of the 64th Annual Conference, Kansas City, 1971; John E. Coons, "Financing Educational Variety for the Poor," National Tax Association, Proceedings of the 64th Annual Conference, Kansas City, 1971; A. Edward Simon, "Governor Milton J. Shapp's Proposal for National Educational Trust Fund," in Financing Public Schools, Federal Reserve Bank of Boston (Conference Series No. 7) January 1972.

4. the method (if any) for transfers of funds either among units at a given level (ie, between school districts) or from one level to another (as in state aid to local school districts).

Restructuring may also involve a change in the manner in which public educational funds are expended, either independently, or as part of a larger program of taxation reform. Structural changes in spending could include:

5. changing the level of teacher hiring (from the district to the school or from the district to the state, for example)
6. changing the number of units that are hiring teachers at the same level (ie. changing the number of school districts)
7. changing the level at which other instructional decisions are made (type of curriculum, teacher/student ratio, etc.)

These seven dimensions of financial reform will be used in the discussion of the proposals for unit state financing, state equalization, variations of the voucher system, and other methods of equalizing and or centralizing the financial administration of school districts. Our findings have some implications for each of the dimensions of educational finance and for all of these reform programs.

UNIT STATE FINANCING[2]

Moving the entire finance of public elementary and secondary education to the state level would have the effect of reducing to one the number of taxing districts in the state. It would thus clearly involve a shift in the level of government at which taxation takes place and, most likely, a shift to the state level of some spending and administrative functions that are presently local responsibilities. It is not unlikely that the unit state system will be associated with changes in the type of taxation and the institutions through which taxes are approved, but such changes are not essential to the nature of the unit state system.

Our findings show a strong and significant association between the number of school districts in the county and the levels of support of education and teachers' salaries. Financial support is greater when the district is small and relatively homogeneous and the parents and taxpayers identify easily with the goals of the educational programs. A unit state system may decrease the size of the spending and hiring unit, and it would cut the very direct and immediate connection between the payment of taxes and selection of expenditures for services in the home community. This, it seems to us,

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[2]See: James B. Conant, "Full State Funding," in Financing Public Schools, Federal Reserve Bank of Boston (Conference Series No. 7) and Charles Benson, "State Assumption of Educational Costs," National Tax Association, Proceedings of the 64th Annual Conference, Kansas City, 1971.

would tend to reduce the willingness of the taxpayers to support the levels of taxation required to raise the average quality of education. Indeed, we suggest that if other things (institutions for tax approval and level at which spending occurs) remain constant, a unit state system is likely to result in spending levels below those that would otherwise be achieved.

In the market for public school teachers, the equalization of revenues among districts may well imply a lessening of competition for the best school teachers among the wealthier districts in the state. If this results in lower salary levels in the wealthy area, it implies a larger number of teachers hired overall, assuming the total wage bill for instruction remains unchanged. This in turn implies a general Teacher/Student ratio somewhat higher than before equalization. The presence of teacher unions and strong vested interests in the current salary structure would probably limit changes in compensation to differential increases which would over time lead to a general leveling of salaries. If all teacher hiring were done at state controlled and uniform salaries, competition in salaries would be eliminated and salaries would tend to fall relative to salaries of other professions in the state.

The move to a unit state system will have the least impact on spending levels and teacher salaries where present school districts are few and large. In such areas, competition for teachers is not significant, and the close identification of the voters with very localized school systems may already be lacking. Choice available to parents among public school systems may already be too limited to produce the effects we have postulated earlier in this report.

If districts were allowed to supplement their allocations under a unit state system, the result could be quite similar to the present system in that spending and taxing decisions at the margin would be seen as involving a local sacrifice for local gain, and the greater homogeneity of the district may result in greater spending.

If the move to a unit state system produced an income tax to support education, the expected reductions in support levels might be offset, at least in part. Similarly, to the extent that local communities lose their veto power over tax levies for educational expenditures it is possible that these expenditures will rise. This is an issue which we suggest for further research in the next section of this report.

STATE EQUALIZATION[3]

State equalization programs can come in a wide variety of forms. The implications of the present study are strongest for those programs that would change the relation between taxation and the local investment of the proceeds in locally desired educational programs at the margin. In less technical language, we mean simply that is is the perceived relation between additional taxation and additional direct benefit to the family or community that is likely to be most significant in the determination of willingness to provide additional revenue to education. Where state equalization would not allow the community to supplement the equalized spending amount, we expect

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[3]See especially: Coons, Clune, and Sugarman, Private Wealth and Public Education, op, cit. for discussion of District Power Equalization (DPE).

that communities would lose that identification between the spending and the result and that their willingness to support public education would decline. Equalization, in other words, could be at a level below the current average.

A unit state system designed to raise the level of the low spending districts, yet still allow other districts to indulge their tastes for spending beyond the average seems much more likely to retain the willing financial support of the communities. It would allow for a variety of spending levels that would provide to families a choice of school districts in which to live. If parents are not allowed to indulge their taste for superior educational opportunities for their children in the public sector, it seems likely that they would turn to private education. Interest in and support of the public school system would suffer accordingly.

How state equalization might affect the levels of total spending is also dependent on the organization of the state's educational system prior to the change. If the dominant districts in the state (ie. those serving the principal population areas) do not now operate in competition with surrounding districts for both teachers and residents, then the switch to a statewide system of equalization may have little impact. The large districts that encompass entire metropolitan areas would have already provided a great deal of equalization. On the contrary, in a state where most of the population is concentrated in highly fragmented districts, many of which are homogeneous at levels of spending well above or below the state average, a move to state equalization of spending would result in a substantial change in the status quo and would, in our opinion, change the willingness of taxpayers to pay for education and the forces determining the level of teacher salaries.

VOUCHER SYSTEM

A voucher system would give the parents greater choice in selecting the school that his or her children would attend. The parents would generally have the option of sending their offspring either to a public school of their choice or, with some voucher systems, to a private school. The essence of the system is allowing parents greater latitude of choice without having either to "vote with their feet" by moving their residence in order to change the public schooling their children receive or to seek private school alternatives without state support.

At the local level of implementation, a voucher system would not disturb the level at which financial decisions are made or at which the financial burden is placed. A local voucher system would serve to increase mobility among schools in the district but the amount of actual choice would depend on the size and heterogeneity of the district.[4] In a small and homogeneous

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[4]If the vouchers could be spent outside the district, or if there is free entry into the supply of educational services within the district, choice will be a function of the heterogeneity of the surrounding community in addition to that of the district itself. The amount of diversity that can be financed will also be determined by the size of the vouchers and thereby by the system developed for educational finance.

district a voucher system limited to the public schools would probably have a minimal impact on the amount of choice that parents exercise. In a large district with a wide range of income and educational groups, as well as a variety of educational philosophies, the range of opportunities for differing educational experiences would be substantial.

A voucher system implemented at the state level, which allowed parents to cross existing district boundaries in selecting a school, would greatly increase choice, especially where present districts are small and homogeneous. This assumes, of course, that the state voucher system does not come with other state restrictions which would reduce local control of the schools and force homogeneity.

A state voucher system may further increase the variety of educational experiences available to the poorer districts by absolutely increasing their spending per child and/or by relating the size of vouchers to the needs of the child. Coons, for example, suggested a "Needs Adjustment Model" (NAM) which would provide the same base voucher for all but supplement that amount by up to 100% for children with special needs or handicaps.[5] Since parents would not be allowed to supplement the voucher, spending levels per student woudl be equalized.

A much broader array of choices in education might come from plans which would allow parents some latitude in the amount of spending on their children's education. In addition to choosing the type of school, the parents could select their level of educational spending in such a way that most nearly equalizes the burdens imposed. Coons has suggested "family power equalizing", and the Institute for Government Studies has published a fifty page sample statute which would have this effect.[6] Such a program would essentially equalize the fraction of its income that a family would have to sacrifice to provide a given level of educational spending. There would be both a floor and a ceiling on total spending per student, but the family could choose the actual spending level from this range.

Offering parents a wider range of choices for the education of their children ought to, on balance, induce them to be more supportive of education. If the voucher system is local and the tie between tax levy and the size of the voucher (and the quality of education obtainable) is well understood, support for education ought to increase. A voucher system at the state level which equalized spending per student could well have the effect of breaking the identification between imposition of the tax and the realization of the benefits since the relation between one's own tax burden and the education received by children in the neighborhood would become much less clear. In such a circumstance support for educational programs could become much weaker. Coons' equalizing plans could avoid some of this difficulty by relating additional tax effort to additional local funding for education. A tie between tax effort and direct benefit from educational spending, at least at the margin, would seem to be a minimum requirement to retain taxpayer enthusiasm for increased school levies.

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[5] J. Coons, "Financing Educational Variety for the Poor," op. cit.

[6] J. Coons and S. Sugarman, Family Choice in Education: A Model for State Voucher Systems, Berkley, Institute for Government Studies, 1971.

A voucher system which resulted in a greater variety of educational opportunities for students would at the same time, produce a greater array of opportunities for teachers. Competition among schools for the best teachers (defined as those most attractive to children and their parents) would result in a higher level of salaries for these teachers. On the other hand, without any mandated uniformity, the salaries paid to teachers less well qualified to attract and hold students could fall. In a situation of overall excess teacher supply it is quite possible that the overall level of teacher salaries could decline in spite of increased competition for teachers. In the longer run, however, greater competition for teacher services and an increase in spending levels for the poorer districts should result in greater earnings for teachers as a group.

OTHER PROPOSALS

This section will highlight some other types of reform proposals and indicate for each the impact it wolld have on the structure of the educational market.

Raise Minimum Levels of State Support. The level of spending mandated and supported by state governments tends to be low enough that even the poorest districts see the need to supplement this minimal program. A substantial increase in the minimum educational offering mandated for each district and the funding of this program directly by the state (at least for districts not able to bear the burden themselves) would move a long ways toward equality of educational opportunities. Such a program would leave the structure of the education market essentially unchanged. There would be increased competition for teachers only insofar as poor districts became stronger competitors. We can see no effect of such a program on support for educational spending among taxpayers.

Redraw School District Boundaries to Equalize Tax Base. Redrawing existing school boundaries to equalize the market value of tax base per student would reduce to zero the inqquality between districts in ability to pay for education. Such a program would result in a massive consolidation that would decrease price competition for teachers and thereby depress their salaries. It would also reduce the direct connection between taxation and directly recognized private benefits. The new and larger districts would be more heterogeneous and probably less agreed on the proper educational strategy. Our model predicts that a system would be associated with lower expenditures per capita and lower teacher salaries.

Massive Increase in Federal Support for Public Education. Governor Milton J. Shapp of Pennsylvania has proposed that the federal government take over the bulk of school financing. Districts would receive a large enough portion of their total funds from the federal government so as to reduce greatly the financial hardships of the less advantaged school districts and assure a greater degree of equality in educational opportunities.[7] The federal program of aid would be financed by a tax progressive with both education and

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[7]See A. Edward Simon, "Governor Milton J. Shapps's Proposal for a National Education Trust Fund," in Financing Public Schools, op. cit.

income. The burden would thus be borne most heavily by those to whom the benefits were greatest. The plan calls for 50% federal funding of education, 40% state funding and only 10% local funding. In the market for teachers, the number of districts competing would remain unchanged. Likewise the homogeneity of the local school district would remain unchanged. The lower percentage of total revenue coming from the most homogeneous local unit may reduce total support for education in the long run (an implication implicit in the model developed here) but seems likely to increase support in the short run as local taxes are cut to compensate for increased federal funding.

Centralization of Non Residential Tax Base. A program which seems to us most promising is the concentration of commercial, industrial, and high value residential tax base in a separate pool to be taxed by the state on a uniform basis. Each district would be allowed to tax residential real estate up to the first $50,000 in market value per family unit. The state would tax commercial and industrial facilities as well as that portion of the value of each residential unit that exceeded $50,000. The proceeds of the state educational tax would be distributed to districts in inverse proportion to their residential tax base. Such a plan would provide for substantial equality of educational opportunities without jeopardizing either local control and administration or local choice in setting the levels of school taxes and expenditures and taxes. This program would not alter the present structure of the educational market. Neither competition for teachers nor the degree of homogeneity within districts would be changed. The direct relation between increased local taxation and increased local spending on education would also be preserved. In fact, such a program could be implemented along with decentralization to smaller school districts to enhance the variety of educational systems available.

SUMMARY

We have emphasized the necessity to consider the structure of educational markets in searching for more equal educational opportunities. The homogeneity of the school district seems closely related to the level of expenditures that local taxpayers are willing to make. A change in the number of districts is likely to have an impact on willingness of the taxpayers to pay for education as well as on the size and equality of the tax base. Other things being equal we favor fewer and small school districts. Such districts will assure us diversity of educational opportunities, higher levels of tax support for the schools, and a competitive market for teachers in which wages are determined by supply and demand rather than be administrators in a monopsonistic setting.

Of the major policy choices outlined in the preceding few pages, we are most supportive of the family power equalizing voucher systems and the centralization of non residential tax base. As we stated at the outset of this section, there are many dimensions of the restructuring problem that we are not qualified to deal with. Particularly, this study has not dealt with the quality dimensions on education other than as measured by spending levels. For that reason we refrain from making a full-fledged endorsement of either of these programs. This study has demonstrated the importance of market structure to educational markets. It is our hope that further study of these issues will clarify the remaining questions.

CHAPTER 5

RECOMMENDATIONS

POLICY

Our chief policy recommendation can be summarized most briefly:

> Any major restructuring of public school organization or finance should seriously consider the likely consequences such change will have on financial support by the taxpayers and on the market for and allocation of public school teachers.[1]

We find significant positive association between the number of districts serving an area and the amount of financial support provided for education. These relationships remain significant when a wide variety of extraneous influences have been allowed for. It seems highly likely that, other things being equal, increased fragmentation of school districts would result in higher average spending and salaries and that major consolidation will reduce spending and salaries.

RESEARCH

I. Proposals for Extension of the Model on the Revenue Side

1. The model developed in this project could be usefully expanded to include the determinants of state revenues. The portion of these revenues that are determined by institutional and economic structural variables could be detemmined on a state by state basis.

2. Further testing of the model should allow us to determine the speed with which school districts adjust their spending to changes in (1) the incomes earned by residents of the district[2] (2) the size of the property tax base (3) the number of students in the system and (4) the number of school districts in the area.

3. What is the relation between dollar expenditures and the "quality" of the education offered in the district? One method of isolating "quality" from the demographic characteristics of the districts population is focusing on the difference in scores in the very early grades might be taken to reflect the level of the "environment"

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[1]Public school structure is used here to refer to the number of schools in a given geographic area, the relative sizes of these schools, their degree of autonomy, the ease with which schools can be started or eliminated, and the political level at which taxation and expenditure decisions are made. Most restructuring proposals are intended to change more than one aspect of structure.

[2]As an illustration, See Appendix C.

and changes in percentile scores between early and later grades to reflect the impact of the educational system. Such a measure of quality would be most useful in the expansion of the model and would greatly enhance its usefulness in policy making.

4. How do the (1) type of tax system and (2) the institutional arrangements for setting tax levels affect the amount of revenue forthcoming to finance public education? Specifically, does required voter approval of tax levies lower the level of educational spending? Is financing of education through income taxation associated with higher levels of spending than when financing comes through property taxation?

5. Is there a linkage between the public's appraisal of the benefits of education and the revenues they are willing to devote to it, or is spending determined solely by income levels and property values?

6. Are the private educational expenditures of parents in the home related to (1) the level of expenditures on public education or (2) the variety of public educational systems available in the area? We would expect some efforts by parents to supplement public education where public spending is low and to provide for their individual preferences where there is a lack of choice in the public sector.

7. What effect does the variety of educational programs offered within the school district have on the amount of revenues forthcoming in support of public education? What effect does this variety have on the sensitivity of public support to the number of school districts in the area?

8. Do other locally-provided services complement or compete with education for tax dollars? Are high levels of spending on education associated with high spending on libraries, police, fire, or sanitation service?

9. What effect does competition among school districts have on the levels of capital spending? Do districts maintain better buildings and provide better equipment when they must compete with surrounding school districts for teachers and for residents?

10. What impact does market structure have on the changes in spending made by districts over time? Are competitive districts quicker to adapt to changes in income, population, or wealth? Is the gap in spending in favor of competitive districts tending to widen over time?

II. Expansion of the Model in the Determination of Teacher Salaries

1. What are the determinants of teacher salary structure? What factors for example, govern the spread in salaries between the

entering level and the highest salary which can be earned with a bachelor's degree? What determines the number of steps in the scale? We suspect that competition between school districts will be found to be an important factor in the structure of teachers' salaries as it is in the level of those salaries.

2. Is there any relationship between teacher "quality" and the level of teacher salaries? Within a district? Between districts? Does the structure of the educational market influence this relationship?

3. What measure is there for teacher "quality"? Changes in test scores of students? Extent of education? Quality of the school at which the teacher was educated? Grades in school? Satisfaction of parents and students?

4. How differently does the market for teachers operate under conditions of excess supply of qualified applicants for teaching positions? What change is there in (1) the extent of competition for teachers (2) the effect of competition on wage levels, (3) the desired ratio of teachers to students (4) the speed with which districts adjust the number of teachers to changes in the numbers of students?

5. Is there any tendency for school districts to substitute capital (teaching machines, audio/visual equipment, etc.) for labor (teachers) as the wage paid teachers increases?

6. Is the impact of number of districts in the area on teacher salaries stable over time? Does competition between districts cause a progressive widening spread between the monopsonistic and the competitive districts?

7. What effect would intense competition among schools for students (as with the voucher system) have on the range of teacher salaries? Would the range of salaries increase substantially as the schools compete for the most attractive teachers?

III. Other Extensions of the Model

1. Expansion of the model should help us to predict the impact on private school enrollment of increased choice available to parents among public school systems in their area. We would predict a negative relationship between the number of private school systems in an area and the size of private school enrollment.

2. How do dependent school systems behave compared to independent school systems (1) in sensitivity to market structure (2) in levels of staffing and expenditure (3) in adjustment to changes in economic parameters and population changes?

3. In what way, if any, do unionized districts differ in observed performance from non-union districts? What is the effect on (1) teacher salaries (2) teacher/student ratios (3) expenditures on instructional staff as a percentage of all spending, (4) sensitivity of salaries to market structure and (5) the level of financial support given to education?

4. Are there economics or diseconomies of scale at either the school or school district level that would offset or reinforce the relationships found in this study?

5. What impact does inter-district busing of children have on the relationships found in this study? In particular, what happens to the level of expenditure on public schools, to the level of staffing, and to the sensitivity to the wealth and income of the community?

6. What impact, if any, do religions and ethnic background have on the type of educational system developed in a school district?

7. What is the relationship between size of district and the variety of its educational offerings? Can enough diversity be found within districts to obviate the need for numerous districts?

All of the foregoing extensions of the basic model developed in this project will help us to better understand the importance of school district structure. While all of the listed suggestions are important and deserving of further study, we believe that the three key issues are economies of scale, measuring the output of education, and determining the relationship between the types of political institutions for decision making and the levels of public school funding.

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APPENDIX A

AN ECONOMETRIC PRIMER

1. What is Econometrics?

Econometrics is a field of economics that blends selected elements of mathematics, statistics, and economic theory. Essentially, it is a study of the development of economic relationships, the specification of these relationships according to a particular functional form, and the estimation of the parameters of the function. The primary statistical tool employed in econometrics is regression analysis.

2. And what is regression analysis?

Regression analysis consists of a set of techniques for estimating the parameters of a linear equation. The general form of a linear equation is $Y = a + bX$, where Y and X are variables and a and b are constants. The most common form of estimating technique is the method of least squares.

3. Least Squares

The method of least squares is a way of fitting a straight line to a set of data in such a manner that the sum of the squared deviations about the line is smaller than the sum of the squared deviations about any other line fit to the same data. Consider Figure 1.

In the diagram, Y is said to be the dependent variable; X, the independent variable. The deviations from the points to the line are denoted here by the distances A, B, and C. For a least squares line, $A^2 + B^2 + C^2$ will be smaller than for any other line used to describe these points. In general, if we denote points on the line by Y_c (c for computed), then

$$\Sigma(Y - Y_c)^2 \text{ is a minimum.}$$

In addition to this property, a second characteristic of least squares is that the sum of the deviations from the points to the line is equal to zero: $\Sigma(Y-Y_c) = 0$. For these reasons, the line of least squares is often called the "line of best fit."

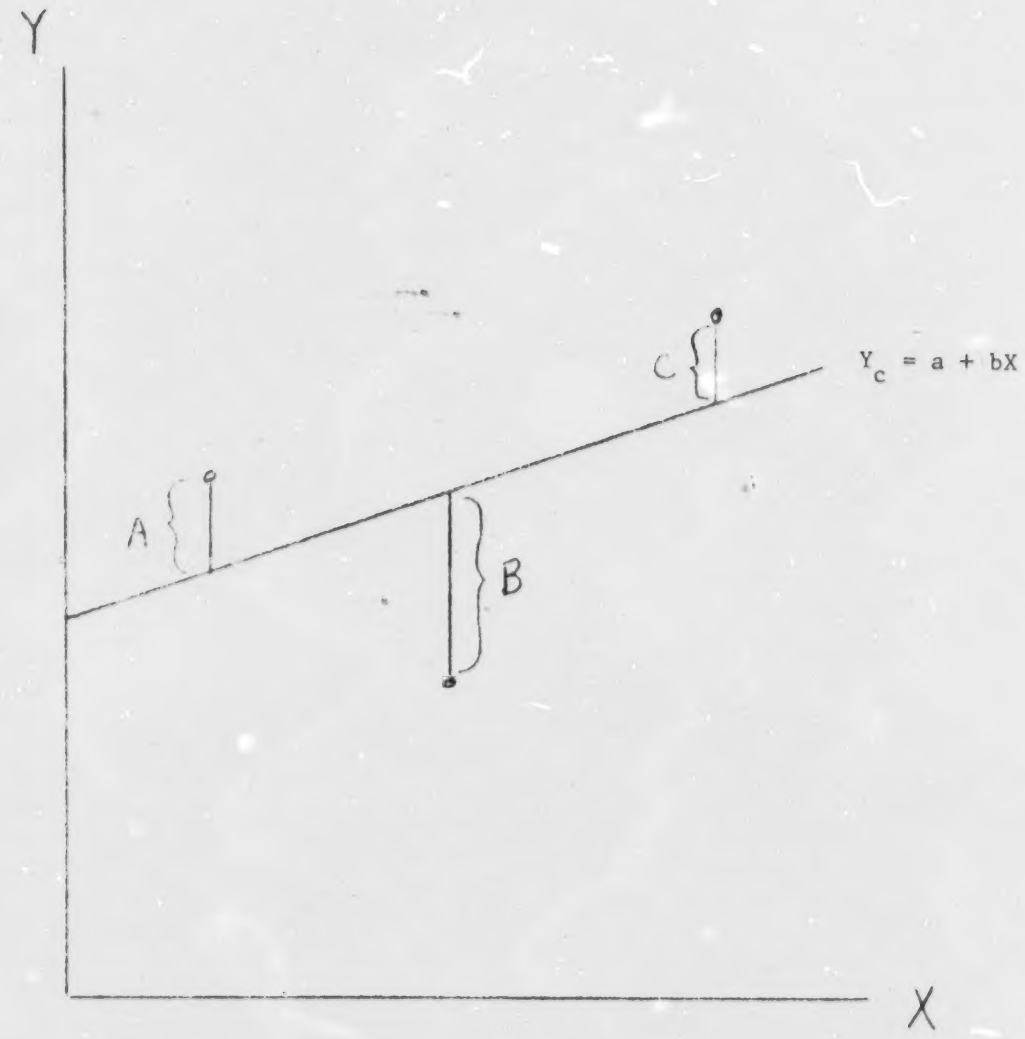
4. How do you find the line of least squares?

If we let the regression equation be described as $Y_c = a + bX$, the trick is to find values of a and b. These values are obtained by simultaneous solution of the two following normal equations.

$$\Sigma Y = na + b\Sigma X$$

$$\Sigma XY = a\Sigma X + b\Sigma X^2$$

Figure 1



In these equations "n" is the sample size, or the number of (x,y) pairs to which the equation is being fitted. These equations reduce to:

$$b = \Sigma(X-\bar{X})\ (Y-\bar{Y})/\ \Sigma(X-\bar{X})^2 \quad \text{and}$$

$$a = \bar{Y} - b\bar{X}$$

5. Can you fit a line of least squares to a set of data that contains more than one independent variable?

Of course. In this case, say with two independent variables, the regression equation might be written as:

$$Y_c = a + b_1X_1 + b_2X_2$$

The normal equations from which a, b_1, and b_2 might be obtained are:

$$\Sigma Y = na + b_1\Sigma X_1 + b_2\Sigma X_2$$

$$\Sigma X_1Y = a\Sigma X_1 + b_1\Sigma X_1^2 + b_2\Sigma X_2^2X_1$$

$$\Sigma X_2Y = a\Sigma X_2 + b_1\Sigma X_2X_1 + b_2\Sigma X_2^2$$

Similar normal equations can be developed analogous for more than two independent variables. The essential property of the regression equation is still that the sum of the squared deviations is a minimum, but the deviations are now about a regression plane rather than the regression line. Obviously, a graphic explanation becomes quite difficult for two independent variables and a real challenge beyond that.

6. Is the line of best fit always a good fit?

Unfortunately, no. A linear equation cannot adequately describe a relationship that is distinctly non-linear, nor can it describe data in which there are no functional relationships between the dependent variable and the set of independent variables. The most common measure of goodness is the coefficient of determination, or R^2

7. What's That?

R^2 attempts to measure the total variation in the dependent variable that is attributable to the relationship with the independent variable(s). Total variation is said to be equal to explained variation plus unexplained or residual variation:

$$\Sigma(Y - \bar{Y})^2 = \Sigma(Y_c - \bar{Y})^2 + \Sigma(Y - Y_c)^2$$

The better the line of fit, the larger is explained variation and the smaller is residual variation. If the line of best fit is perfect, there is no residual variation and total variation will equal explained variation. Thus,

R^2 is defined as the ratio of explained variation to total variation.

$$R^2 = \Sigma(Y_c - \bar{Y})^2 \; / \; \Sigma(Y - \bar{Y})^2$$

For perfect fits, R^2 will be equal to 1.0, while it will be equal to zero if there is no relationship at all among the variables.

However, a word of warning. The value of R^2 is sensitive to the number of observations in relation to the number of independent variables, and it automatically approaches 1.0 as the number of variables approaches the number of observations. For meaningful analysis, the sample size should be much larger than the number of variables employed.

8. Any other warnings?

Yes! A high value of R^2 simply means that the estimated equation gives a good description of the data in the sample. However, correlation does not necessarily imply causation, so the equation may not capture the correct causal relationships. (Does an increase in the money stock cause an increase in GNP, or does an increase in GNP necessitate an increase in the money stock?) Perhaps the correlation in the sample is even due to chance variation rather than to any relationship that actually exists between the variables. Secondly, it is possible that the estimated equation accurately captures the actual relationships among the sample data. However, these same relationships may not continue for data outside the sample period, and the equation will therefore be unsuited for prediction purposes.

Remember! Least squares regression is a purely mechanical concept that can readily be forced upon any set of data (consenting or not) by the modern computer. Sensible use of the technique requires good judgment based upon the experience and knowledge of the researcher. Don't let R^2 be a false friend.

9. How do you guard against the false friendship of R^2?

It's not easy. Reliance upon your own experience is probably the best protection. If you have R^2 of .9997, but the equation "just doesn't look right", it probably isn't.

If you are working in a new area where a record of past experience has not yet been attained, it's more difficult. In this case, if you are using time series data, you might try to eliminate any spurious trends in the data by using first differences of the variables. That is, instead of

$$Y_t = a + bX_t, \text{ try } (Y_t - Y_{t-1}) = a + b(X_t - X_{t-1})$$

With most economic data, the first of these equations will almost always yield a high R^2, but it may be meaningless. A high value of R^2 in the second equation is almost certain to be important. Moreover, the use of first differences often eliminates some more complicated problems that frequently occur in regression analysis.

10. Are there any other limitations to least squares?

Yes, the least squares technique is limited in terms of statistical power. Although least squares lines can be fitted to any set of data, we cannot say anything significant about the statistical properties of the estimates of a and b unless we know something more about the probability distribution of the variable Y. Maximum likelihood estimation overcomes this problem.

11. What is maximum likelihood estimation?

In the maximum likelihood approach, certain assumptions are first posited about the probability distribution of Y. Then, given the assumptions, we try to find the population parameters which would cause our particular sample to be the most likely one to be generated by a random selection process.

12. What are these assumptions?

First, it is assumed that for every value of X, there are many different values of Y that could occur. These values for Y will follow the normal distribution. Secondly, it is assumed that the mean values of Y are linearly related to the X values:

$$\mu_{y/x} = a + bX$$

Third, we assume that the variances of all of these distributions of Y values are equal. We also assume that for any given value of X, the deviation of the Y variable from its conditional mean will be independent of the X value. Other minor assumptions can be added on, but these are the important ones.

13. How do maximum likelihood estimates compare to least squares estimates?

Under the assumptions given above, the maximum likelihood estimates and the least squares estimates will be identical.

14. Then why all the additional fuss about maximum likelihood?

Under the maximum likelihood assumptions, the estimates of a and b will be unbiased estimates of the true values of these parameters for the population. Moreover, the estimates will be normally distributed, and estimates of the standard deviations of these distributions are readily obtainable. Thus, the t-distribution can be employed to conduct hypothesis tests with respect to the values of the population parameters. The figures required to perform such tests are generally provided as a standard part of most computer regression print-outs.

15. Are maximum likelihood estimates always unbiased?

No. If the deviation of Y from its mean is not independent of the value of X, then the estimates will be biased. Bias may also occur if important independent variables are omitted from the equation or if simultaneity is present.

16. What is simultaneity?

The simple equations talked about so far assume that the chain of causation is from X to Y. However, for some relationships, there is also reverse causation from Y to X. This type of problem frequently comes up when price and quantity is included in the same equation. Quantity demanded, quantity supplied, and price are all determined simultaneously, and a simple equation that says that price is determined by quantity (or vice versa) is not likely to be correct. When simultaneity is present, maximum likelihood estimates will be biased and inconsistent.

17. What may be done to overcome the problem of simultaneity?

There is not much that can be done about the problem of bias, but consistent estimates can be obtained by the method of two-stage least squares (TSLS).

18. What is this method?

Let us call all of the variables that are determined by simultaneous interaction to be endogenous. Those variables whose values are determined by relationships outside our model will be called exogenous. We may then get consistent estimates for the coefficients in any given equation in our model by a two stage process. In the first stage, those variables in the equation that are independent and endogenous are regressed upon all exogenous variables that appear everywhere in the model, not just in the given equation. Predicted values for these endogenous variables are then obtained, and these predicted values are used as variables in the given equation, along with whatever other exogenous variables happen to appear in that equation. When ordinary least squares techniques are applied to this equation, and these data, the resulting estimates are still unbiased, but at least consistent.

19. Are there other methods for coping with simultaneity?

Yes. Other popular techniques are indirect least squares and the use of instrumental variables. A description of these and still other techniques can be found in any current econometrics book.

APPENDIX B - STATUTORY REQUIREMENTS FOR LOCAL SCHOOL DISTRICTS

State	Tax Limitation	Maximum Levy Without Vote	No Vote	Tax Vote	Budget Vote	Both	Remarks
Alabama	Yes	3 mills-county		Yes			vote on 3 mill district levy
Alaska	Yes	30 mills	x				
Arizona	No		x				
Arkansas	No			Yes- to increase			
California	Yes	8 for 1-8 9 for k-8 7.5 for 9-12		Yes-to override			
Colorado	No	5% increase	x				vote if more than 5% rate increase
Connecticut	No			Yes			
Delaware	No			Yes			
Florida	Yes	10 mills		Yes-to override			

State	Tax Limitation	Maximum Levy Without Vote	No Vote	Tax Vote	Budget Vote	Both	Remarks
Georgia	Yes	20 mills-county		Yes-to override			
Idaho	Yes	30 mills		Yes-to override			2/3 vote needed
Illinois	Yes	9.2 for 1-8, 9-12 12.5 to 16.0 for 1-12		Yes-to override			20-40 mills final limit
Indiana	Yes	49.5	x				
Iowa	No		x				
Kansas	No (after 1965)				Yes-4% or more increase		Statutes revised 1965 and 1970.
Kentucky	Yes	15 mills		Yes-to override			
Louisiana	Yes	5 mills		Yes-to override			limit is 13-New Orleans, 16-Lake Charles; override up up to 7 additional for current.
Maine	No		x				

State	Tax Limitation	Maximum Levy Without Vote	No Vote	Tax Vote	Budget Vote	Both	Remarks
Maryland	No		x				Districts are dependent
Massachusetts	No		x				Districts are dependent
Michigan	Yes	15 mills		Yes-to override			Limit 50 mills
Minnesota	Yes	$326/pupil	x				Adjusted to CPI
" (after 1971)	Yes	30 mills		Yes-to override			
Mississippi	Yes	25 mills total		Yes-3 mills extra			
Missouri	Yes	6.5 rural 12.5 city		Yes-3x for 1 year, 4x for 4 years by 2/3			
Montana	Yes	125% of Foundation level		Yes-to override			
Nebraska	No		x			x (small districts)	Omaha and Lincoln do not vote on either

State	Tax Limitation	Maximum Levy Without Vote	No Vote	Tax Vote	Budget Vote	Both	Remarks
Nevada	Yes	15 mills	x				
New Hampshire	No					x-except in dependent	
New Jersey	No			Yes			
New Mexico	Yes	20 mills for all levels	x				4.45 mills usual district limit
New York	No						
" " (cities)	Yes	12.5 to 20.0		Yes-60% needed to override		x	Outside cities Six largest city districts are dependent
North Carolina	No		x	Yes for 6 mills over minimum			County levy is not voted on; additional 6 mills is a local levy
North Dakota	Yes	21 to 34		Yes-to override			increase may be up to 75% over limit
Ohio	Yes	10 mills		Yes-to override			

State	Tax Limitation	Maximum Levy Without Vote	No Vote	Tax Vote	Budget Vote	Both	Remarks
Oklahoma	Yes	20 mills		Yes-to override			levy may be increased up to 40 mills
Oregon	No			Yes-on any increase > 6%	6%		
Pennsylvania	Yes	17-25 mills	x				
Rhode Island	Yes	25 mills for all purposes	x				all districts are dependent
South Carolina	No		x				
South Dakota	Yes	20 mills county 20-40 mills local		Yes-75% to increase by 10 mills			
Tennessee	No		x				
Texas	Yes	15 mills		Yes			
Utah	No		x	Yes			Vote is on 1 to 10 mill "voted Leeway program."

State	Tax Limitation	Maximum Levy Without Vote	No Vote	Tax Vote	Budget Vote	Both	Remarks
Vermont	No				Yes		city districts are dependent
Virginia	Yes	30 mills	x				all districts are dependent
Washington	Yes	12 mills for unified		Yes-60% needed			# voting must be 40% of those in last general election
West Virginia	Yes	2.10-8.44		Yes-to override			Override may be up to 100% of limit; 60% majority needed
Wisconsin	Yes	20 mills, 1-8 25 mills, 1-12	x				All cost beyond max. met by state
Wyoming	Yes	9-25 mills		Yes-11 to 30, mill max.	Yes		Budget vote is by "school patrons"

SOURCE: U.S. Department of Health, Education, and Welfare, Office of Education. Public School Finance Programs, 1968-69. (States and Outlying Areas). (Government Printing Office, Washington, D.C.; 1969).

APPENDIX C*

EDUCATIONAL EXPENDITURE PATTERNS, BY STATE

I. INTRODUCTION

The purpose of the funded research is to determine the effects of changing market structure on educational expenditures and output. Because recent court decisions related to financial and racial inequality have suggested substantial restructuring of educational markets, it is important that these effects be isolated quickly.

It is the purpose of this paper to provide part of the historical background that is basic to the major research described above by comparing the expenditures for education by each of forty-two states for the years 1947-1967. Such a study is useful for the overall research because it reflects the states' growth patterns under the market structure that was typical before the recent court decisions. If the new structures that emerge do not affect the total volume of educational expenditures, the historical data should serve as indicators of future expenditure levels. In addition, figures developed from historical time series data may be used to highlight the cross-sectional rankings published by the National Education Association[1] and to add a dynamic element to many studies of state and local government expenditures that include determinants of educational expenditures and measures of elasticity of educational variables with respect to other relevant economic variables.[2]

This study departs from most prior studies by developing a dynamic model that more fully takes into account each state's past history in determining its present expenditures. Part II explains the method of analysis, while Part II gives the findings and compares them to other studies. Part IV summarizes the conclusions.

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*This material was submitted earlier as Interim Report #1.

[1]For example, see the NEA Research Bulletin, February, 1966, pp. 11-14.

[2]The following are typical of such studies. Roy Bahl and Robert Saunders, "Determinants of Changes in State and Local Expenditures" National Tax Journal, March, 1965, pp. 50-57. Glenn Fisher, "Determinants of State and Local Expenditures: A Preliminary Analysis", National Tax Journal, December, 1961, pp. 349-355. Woo Sik Kee, "Central City Expenditures and Metropolitan Areas", National Tax Journal, December, 1965, pp. 337-353. Jack Osman, "The Dual Impact of Federal Aid on State and Local Government Expenditures", National Tax Journal, December, 1966, pp. 362-372. Seymour Sacks and Robert Harris, "The Determinants of State and Local Government Expenditures and Intergovernmental Flows of Funds", National Tax Journal, March, 1964, pp. 75-85. David L. Smith, "The Response of State and Local Governments to Federal Grants", National Tax Journal, September, 1968, pp. 349-357.

II. METHOD OF ANALYSIS

For several reasons, states are not immediately able to adjust the level of educational expenditures in response to changes in the underlying determinants of these expenditures.[3] Property tax collections may lag behind changes in income and other important determinants. In many cases, new property tax levies have to be voted upon, perhaps gaining approval only after the second or third appearance on the ballot. Unfavorable interest rates may delay bond issues for school construction. Finally, voters may simply take a while to adjust to higher income levels before they support higher educational expenditures. Whatever these reasons, the level of educational expenditures will depend upon events that occurred in previous periods.

One method to capture the effect of prior activity on current expenditures is to employ a distributed lag in a regression equation. For example, if Y_t is some measure of educational expenditures for period t, and if X is an important determinant of such expenditures, we might have:

$$Y_t = a + b_o X_t + b_1 X_{t-1} + b_2 X_{t-2} + \ldots + b_m X_{t-m}$$

In this equation, the current value of educational expenditures would be affected not only by the current value of X, but also by the values of X in the previous m periods. Unfortunately, most of our data do not extend far enough back to give us sufficient observations for this approach. The fact that we would have a large number of independent variables in the equation relative to the total number of observations would seriously impair our ability to make meaningful statements about the results.

The approach to be used in this paper will be a variant of the stock adjustment model. We will assume that at any given time, there is some target level or goal of educational spending to which the governmental unit seeks to elevate itself. However, because of the many lags involved in changing expenditures, the governmental unit is able to increase expenditures by only a fraction of the difference between the target level and the level which it had actually attained in the previous period. Thus, the equation to describe this type of activity is:

$$\Delta Y_t = k(Y_t^* - Y_{t-1})$$

In this study, ΔY_t denotes the change in the real or price-deflated[4] educational expenditures per student in average daily attendance, Y_t^* is

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[3] Sharkansky found that an important determinant of state and local government expenditures in the current period was the level of expenditures in the immediately preceding period. See Ira Sharkansky, "Some More Thoughts about the Determinants of Government Expenditures", National Tax Journal, June, 1967, pp. 171-179.

[4] For the study period, no suitable price index exists that adequately measures changes in the cost of education. The price index that was used for this study was the deflator for purchases of goods and services by state and local governments. Thus, the "real value" of educational expenditures is merely the value in terms of an alternative bundle of state and local expenditures.

the desired level of real expenditures per student in ADA, and Y_{t-1} is real expenditures per ADA for the previous time period. The value of k is the fraction of the difference between the desired level and the previous level that will be made up in any given time period. Accordingly, the value of k can take on only values between zero and one if it is to be meaningful. This fraction is usually referred to as the speed of adjustment. For an example, assume that in some period, the desired level is $400, and the actual is $300. If k is one-half, then the change in expenditures for the current period will be $50, so the total level of expenditures will be $350. In the next period, if the desired level does not change, then the change in expenditures will be $25 (1/2 of the difference between $400 and $350), so the total level will be $375.

However, it is unreasonable to assume that the target level of expenditures will remain constant from one period to the next. In fact, the desired level of educational expenditures should be a function of several other variables, including income, number of students, state and federal educational support, the quality of the educational program, and the level of other public services (that also require tax support). Again, however, the paucity of past observations limits our ability to add all of them into the regression equation, even if current data series were available. Accordingly, we shall use the level of per capita state income as the only explanatory variable for the level of desired expenditures per student in ADA. Letting X_t represent real per capita personal income,[5] we will write:

$$Y_t^* = a + bX_t \qquad (2)$$

Then, substituting equation (2) into equation (1):

$$\Delta Y_t^* = ka + kbX_t - kY_{t-1} \qquad (3)$$

Ordinary least squares can then be applied to equation (3) to yield estimates of ka, kb, and k. The intercept and the regression coefficient can then be divided by the estimate of k to find a and b.

The appeal of this approach is that we can obtain measures of both the short run and the long run impacts of a change in per capita income upon the level of educational expenditures. The regression coefficient kb gives the change in educational spending that will result in the current period from a change in per capita income of one dollar. However, this will understate the long run effects since this represents only a partial closing of the differential between desired and actual expenditures. The long run effect can be obtained from the coefficient b in equation (2), which shows the total change in educational expenditures that will result from a one dollar change in per capita income after enough time has elapsed to close the initial differential between actual and desired levels. Of course, since k is a positive fraction, the value of b will be greater than kb.

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[5] Personal income is deflated by the consumer price index.

III. REGRESSION ANALYSIS

Usable data on current educational expenditures, average daily attendance, price indices, and per capita personal income were obtained for forty-two states for the period 1947-1967.[6] These data were then fitted to equation (3).[7] The results of the computer tabulations are presented in Table I.

For the forty-two states, "reasonable" results were obtained for every state except Montana, for which the speed of adjustment was negative (and not significantly different from zero). Column 1 of Table I shows the short run effect of a change in per capita personal income on current educational expenditures per student ADA. The values range from lows of .002 (Montana) and .003 (Ohio) to highs of .164 (Alabama) and .238 (New Mexico). The average for all forty-two states was .076. Speeds of adjustment, excluding Montana, ranged from .022 (Maine) and .035 (New Jersey) to .997 (New Mexico) and 1.00 (Alabama), with the average being .425. Of course, a speed of adjustment of 1.00 implies that the desired level of expenditures is made in every period. The long run effects are given in Column 6 of the table. The average here is .216, with the range extending from .037 (Ohio) and .094 (Nebraska) to .508 (Maine) and .917 (New Jersey).

It is difficult to assess the accuracy of these estimates because of the lack of comparable benchmark data. Most previous studies that have dealt with the subject have not only used cross-sectional data, but also used educational expenditures per capita as the dependent variable rather than expenditures per pupil. Renshaw, however, used expenditures per pupil and found that an increase in per capita income of one dollar was associated with an increase in expenditures per pupil of about fourteen cents.[8] This is very close to the average of the short run and long run coefficients in Table I. To compare the present study to others dealing with expenditures per capita, the long run coefficients above would have to be multiplied by .18, the percent of the total population in average daily attendance at public secondary and elementary schools.[9] After

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[6] Income figures were obtained from Survey of Current Business, August 1968. Figures on educational expenditures from Biennial Report of the U.S. Office of Education, selected years, and from miscellaneous reports and publications of the National Education Association, Washington, D.C. Price indices were taken from Economic Report of the President (1968).

[7] For each state, the regression results were checked for first-order autocorrelation. Where the Durbin-Watson statistic indicated that auto-correlation was serious, variables were transformed using the Orcutt-Cochrane approach, and an iterative estimation procedure was used. The values of R^2 in the table apply to the equations with the transformed variables. See D. Cochrane and G.H. Orcutt, "Application of Least Squares to Relationships Containing Auto-Correlated Error Terms", Journal of the American Statistical Association, March, 1949, pp. 32-61.

[8] Edward F. Renshaw, "A Note on the Expenditure Effect of Aid to Education," Journal of Political Economy, April, 1960, pp. 170-174.

[9] Using 1960 data.

TABLE I

REGRESSION ANALYSIS

STATE	kb	σ_{kb}	k	σ_k	a	b	R^2	η
Alabama	.164*	.035	1.00 *	.218	-22.56	.164	.60	1.11
Arizona	.149*	.045	.791*	.215	7.95	.188	.48	.98
Arkansas	.058	.043	.198	.210	-145.43	.295	.53	1.61
California	.131	.052	.768*	.255	-29.69	.171	.37	1.07
Delaware	.045	.034	.276	.145	-2.20	.163	.36	1.01
Georgia	.109*	.028	.580*	.165	-58.26	.188	.60	1.25
Idaho	.059*	.024	.435*	.180	37.33	.135	.34	.87
Illinois	.102*	.031	.731*	.215	50.22	.140	.37	.88
Iowa	.035	.020	.184	.121	6.94	.192	.34	.98
Kansas	.085*	.028	.442*	.160	-39.90	.193	.45	1.11
Kentucky	.119*	.043	.518*	.218	-121.43	.229	.28	1.54
Louisiana	.115*	.034	.502*	.150	-29.23	.229	.46	1.09
Maine	.011	.027	.022	.135	-256.56	.508	.17	1.41
Maryland	.062	.036	.310	.175	-72.98	.200	.26	1.19
Massachusetts	.064	.032	.406	.229	23.07	.157	.44	.94
Michigan	.017	.020	.111	.107	90.18	.155	.31	.80
Minnesota	.042	.029	.190	.148	-23.39	.223	.50	1.06

*Significant at the .05 level

TABLE I

REGRESSION ANALYSIS

STATE	kb	σ_{kb}	k	σ_k	a	b	R^2	n
Mississippi	.064*	.030	.274*	.132	-73.09	.232	.22	1.38
Missouri	.047	.032	.213	.154	-111.88	.222	.24	1.33
Montana	.002	.043	-.046	.165	346.87	-.035	.18	-.26
Nebraska	.029*	.013	.311*	.122	142.46	.094	.52	.57
Nevada	.023	.031	.219	.164	131.51	.103	.42	.68
New Hampshire	.057	.029	.345	.221	17.58	.167	.21	.95
New Jersey	.032	.035	.035	.177	1577.31	.917	.33	.60
New Mexico	.238*	.052	.997*	.185	-92.17	.239	.50	1.27
New York	.082	.059	.164	.169	-680.29	.500	.36	2.12
North Carolina	.131*	.035	.728*	.205	-38.27	.180	.42	1.17
North Dakota	.023*	.010	.168*	.067	129.46	.139	.52	.64
Ohio	.003	.030	.088	.146	312.01	.037	.20	.21
Oklahoma	.084*	.031	.553*	.177	31.54	.152	.45	.89
Oregon	.099*	.035	.389*	.124	-116.73	.254	.48	1.27
Pennsylvania	.088*	.031	.407*	.142	-75.79	.216	.38	1.20
Rhode Island	.078	.054	.384	.243	-57.86	.204	.16	1.15
South Carolina	.098*	.017	.560*	.111	-20.48	.175	.70	1.09

*Significant at the .05 level.

TABLE I

REGRESSION ANALYSIS

STATE	kb	σ_{kb}	k	σ_k	a	b	R^2	η
South Dakota	.022	.017	.149	.128	109.82	.151	.32	.70
Tennessee	.103*	.033	.598*	.216	-35.77	.172	.51	1.16
Texas	.076*	.034	.466*	.179	5.46	.164	.61	.98
Virginia	.144	.081	.577	.451	-177.12	.250	.38	1.67
Washington	.074	.037	.471*	.207	34.21	.158	.23	.91
West Virginia	.061*	.025	.299	.158	-61.16	.204	.40	1.24
Wisconsin	.057	.032	.235	.142	-98.38	.246	.33	1.24
Wyoming	.119*	.040	.310*	.107	-388.79	.384	.46	1.89
Mean	.076		.425			.216		1.07

*Significant at the .05 level.

TABLE II

Income Coefficients for Educational Expenditures[a]

Study	Data	Regression Coefficient
Fisher[b]	1957, 48 states	.024
Kee[c]	1957, 35 central cities	
	total expenditures	.024
	current expenditures	.017
Osman[d]	1960, 48 states	.037
Fabricant[e]	1942, 48 states	.024
Sacks-Harris[f]	1960, 48 states	
	without federal aid	.034
	with federal aid	.037
Baird	1947-67 time series	
	average of 42 states	.039[g]

[a]The coefficients in the table are the regression coefficients for the income variable in a multiple regression equation with educational expenditures per capita as the dependent variable. The number and choice of independent variables is different among these studies.

[b]Glenn Fisher, "Determinants of State and Local Government Expenditures: A Preliminary Analysis", National Tax Journal, December, 1961, pp. 349-355.

[c]Woo Sik Kee, "Central City Expenditures and Metropolitan Areas", National Tax Journal, December, 1965, p. 346.

[d]Jack Osman, "The Dual Impact of Federal Aid on State and Local Government Expenditures", December, 1966, p. 366.

[e]Solomon Fabricant, The Trend of Government Activity in the United States since 1900, (New York: National Lureau of Economic Research, 1952), p. 124.

[f]Seymour Sacks and Robert Harris, "The Determinants of State and Local Government Expenditures and Intergovernmental Flows of Funds", National Tax Journal, March, 1964, pp. 75-85.

[g]Adjusted from educational expenditures per student in ADA.

making this adjustment, the long run average coefficient for per capita income is .039. Table II shows that this is generally larger than the effect found in most other studies.

Although the long run income coefficient is larger than that found in most other studies, the same is not true for the coefficient of elasticity. Here, the elasticity coefficient is the percentage change in desired educational expenditures per pupil resulting from a one percent change in per capita income, each measured at mean values. In the present study, the long run elasticities range from .21 (excluding Montana) to a high of 2.12, with a mean close to unit at 1.07. This average is quite near the elasticity of 1.09 found by Hirsch[10] for selected years between 1900 and 1958, but substantially less than the national average of 1.34 found by McLoone[11] for the period 1947-1958. In fact, McLoone found only four states with elasticities below 1.00, while the present study indicates that there were at least seventeen such states in the post war period. Two yet different measures of elasticity are 0.78 found by Fabricant[12] in 1942, and 1.1387 found by Smith[13] for fiscal 1965.

IV. CONCLUSIONS

The present study indicates that simple regressions of current levels of educational expenditures upon current levels of independent variables may underestimate the long run impact of income changes. The present study seeks to compensate for this by employing a variant of a stock adjustment model that attempts to isolate both the short run and long run effects of real income changes on the real level of educational expenditures. Although the degree of freedom problem restricts the number of variables that can be included in this model, the conclusion is tentatively offered that there is a distinct adjustment pattern for educational expenditures that yields a long run income coefficient that is greater than has been found in most previous studies.

Several limitations and weaknesses, however, are present in this particular formulation of educational expenditures. First, education is just one of many public services that compete for taxes out of increasing

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[10]Werner Hirsch, Analysis of the Rising Costs of Public Education, Study Paper No. 4, Joint Economic Committee of Congress (Washington, 1959). Reprinted in part in Charles S. Benson (ed.), Perspectives on the Economics of Education (Boston: Houghton-Mifflin Co., 1963).

[11]Eugene P. McLoone, Effects of Tax Elasticity on the Financial Support of Education (Doctoral dissertation, University of Illinois, 1961). Cited in Jerry Miner, Social and Economic Factors in Spending for Public Education (Syracuse: Syracuse University Press, 1963), p. 51.

[12]Solomon Fabricant, The Trend of Government Activity in the United States since 1900 (New York: National Bureau of Economic Research, 1952), p. 125.

[13]Smith, op. cit., p. 353.

income levels, and a simultaneous equation model would no doubt be more appropriate than the single equation model employed here. When more data on other types of public expenditures become available, the simultaneous equation method should be used. Secondly, the period involved in the study includes educational booms that followed World War II and Sputnik. This period might not be representative of the behavior patterns of more tranquil years. Finally, many relevant variables other than per capita income are excluded from the regression equations to safeguard degrees of freedom. Inclusion of additional explanatory variables may alter the results somewhat. Obviously, much more study is required.

Despite these limitations, the study is quite informative in displaying the diversity of behavior patterns that have existed in the various educational expenditures programs of the states. Not only is there great variation in both the short run and long run effects of changes in income, but there are also substantial differences in the rates at which the states respond to changes in income. It is not likely that changes that the individual states may initiate in educational finance programs and the composition of school districts will lead to a significant reduction in this diversity.

Diversity of expenditure patterns is, however, not the major focus of the funded research. We are more interested in how changes in the structure of the educational markets will affect the level and growth of educational expenditures. As shown above, for the period 1947-1967, the average income elasticity for the forty-two states covered was 1.09. This meant that each one percent increase in income was accompanied by, on the average, an increase in per pupil expenditures of slightly more than one percent. Accordingly, any structural change that decreases support of the school system by taxpayers could easily cause educational expenditures to grow less rapidly than income, while a change that increases support could lead to another educational boom. Structural change in educational markets is therefore of more than mere academic interest.